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EDWARD STEVENS ROBINSON

(1893–1937)

BY JAMES R. ANGELL
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It is difficult to speak with restraint of Edward Stevens Robinson, whose sudden and untimely death on February twenty-seventh last brought a shock of deep grief to scores of his friends. It is peculiarly difficult for me to do this, for he had been a favorite student of mine at Chicago twenty years ago. I had followed his career with almost parental affection and interest, and I had been grateful for his companionship as a colleague at Yale for ten happy and fruitful years. To see him needlessly cut down in the full flower of his strength and while he was still steadily developing was a devastating experience. Following as it did, so shortly after the equally premature death of his gifted wife, Florence Richardson Robinson, another of my pupils, it left me stunned and utterly dismayed.

Robinson was born in a small Ohio town forty-four years ago and received the usual public school education. When he entered the University of Cincinnati, a very thin, lightly-built boy, he attracted attention more by his active wit and unbounded energy than by any evidences of scholarly capacity. He was quickly immersed in all kinds of student activities where his qualities of leadership were immediately recognized and eagerly accepted. Debating and college journalism particularly attracted him, and he finally became editor of the college paper, not to mention being manager of the football team. By the time he graduated he had won the McKibben Medal accorded to the senior best exemplifying the highest ideals of a

scholar and a gentleman. He had also been made a student assistant in psychology. All this indicates a lad of perfectly normal undergraduate interests, displaying rapidly growing intellectual abilities.

After graduation from the University of Cincinnati he spent a year at the Carnegie Institute of Technology in Pittsburgh where a strong staff had been assembled in the field of psychology, several of them former students of mine. In 1917, largely as a result of these contacts, he came to the University of Chicago and took his doctorate in my department in 1920, having served in the Trade Test Division of the War Department during a portion of 1918. After a year as instructor in psychology at Yale, he was appointed assistant professor at Chicago, being promoted to an associate professorship in 1923. In 1921 he married Florence Richardson, then on the staff of the University. Visiting lectureships at Harvard and Yale in 1926 and 1927 were followed by a professorial appointment at Yale in the latter year. He had been accorded membership in many scientific societies and learned organizations, in several of which he had occupied official positions. He was editor of the PSYCHOLOGICAL BULLETIN from June, 1930, to December, 1934. In 1935 he became an editor of the *Journal of Social Psychology,* and from 1925 to 1935 he had served as a coöperating editor of the *American Journal of Psychology.*

While all this was going on he had found time to write six books and fifty-seven papers, sixteen of the publications being under joint authorship, most of them with his wife. This is a remarkable record, especially when regard is had to the very high quality of the material both as to content and literary style, and the unusual range covered by it. While some of the papers are of a popular character and were written for non-scientific publications, none that I have ever seen were thin or superficial, and none were lacking in that striking gift for pungent and forceful writing which he had been developing in such telling fashion. Specially deserving of notice are certain of his reviews where solid achievement and self-complacent dogmatism each receives its just reward.

It was a fortunate circumstance that his early professional training stressed the technical and experimental aspects of psychology. Here he produced a considerable body of admirable work, primarily directed at the ancient citadel of memory and association theory, and at the psychology of the learning process and the organic results of mental work. To all these he brought fresh and penetrating insights and a fine critical sense, generous but shrewd and tenacious. This

discipline equipped him with knowledge of experimental technology and the application of statistical methods to psychology, and also familiarized him with the literature of both. It gave him competency to speak in a field where *ex cathedra* utterance all too readily tends to silence fresh voices. It made him a scathing critic of mere sham and pretense. But more important than this, it provided him with a stabilizing point of view, a solid foundation on which to build the edifice of his later interests in sundry fields of applied psychology. The shoddy and shabby character of a good bit of the charlatanism calling itself applied psychology is certainly responsible for the discredit from which bona fide psychology has sometimes suffered in recent years. Robinson's work was always scientifically careful and this early discipline to which I have referred enabled him to combine with his contagious natural enthusiasm for ventures which he felt worth while, a fundamental sanity, a feeling for practical and scientific realities, which never deserted him and repeatedly saved him from blunders that a less well-trained man would inevitably have made. I am sure that in entering some of the fields which in later years he cultivated, he well knew that he was exposing himself to the critical side-glances of the conservative traditionalists. But he was a courageous person not to be deflected by fear of loss of caste from pursuing any course which seemed to him sound and socially fruitful.

It is obviously impossible within the limits of this sketch to deal in detail with his writings. I can at best touch on a few trends which are to be detected in his later work.

Early in his professional career he began to disclose interests in the social aspects of psychology, not primarily in the field of theory, but rather in the area which he discerned in numerous practical social problems where there was need for the insights and understanding that he felt psychology could and should furnish. One of the first openings enabling him to put his convictions into execution came with the opportunity to study empirically and experimentally the problem of the great museum as an instrument of public education. This engaged his active attention for a number of years. Then came an opportunity, reflecting the influence of the Yale Institute of Human Relations, to collaborate with members of the faculty of the School of Law in studies of the fundamental psychology underlying the principles of jurisprudence. Here he produced some of his most brilliant writing and teaching. The latest expression of his interest in this direction was the division of general studies in the graduate school, whose creation was in no small measure due to his vision and

enthusiasm, and to his hands immediate responsibility for its progress was speedily confided. This project is an effort, thus far astonishingly successful, to put the resources of a great university at the disposal of intellectually mature persons for purposes of further discipline in a variety of directions for which their professional callings make demands. The emphasis commonly put by our graduate schools upon highly concentrated specialization has its historic explanation and its intrinsic justification. But there are many callings and many serious intellectual interests essential to the welfare of the modern community of which the American graduate school ordinarily takes no cognizance. It can and should meet this need and Robinson, with the support of Dean Furniss and the graduate faculty, was keen to see an appropriate general training offered to such persons as could profit by it; *e.g.* park directors, museum directors and curators, conductors of forums, librarians, secondary school officers and teachers, etc. These persons require a broad but severe discipline in a number of practically related fields which ordinarily transcend the boundaries of any one university department. The offerings of these departments to persons on the way to the doctorate are consequently quite inadequate and often irrelevant to the scholarly requirements of such groups as I have indicated and many others like them.

Robinson threw himself into all these enterprises with characteristic spirit and enthusiasm. He had to work out new techniques. He had to convert the skeptical and the unsympathetic. He had to break down obstinate prejudice and distrust. All these things he accomplished while carrying a heavy schedule of regular university teaching and shouldering more than his fair share of committee work. That he succeeded so well is partly attributable to his sheer personal charm, his good nature, his sterling character, and his broad human sympathies; but in large measure is due to his fertile mind, his wide outlook on his problems and the complete impossibility of permanently disheartening or thwarting him. If he found himself blocked at one portal, he wasted no time trying to force it, but promptly discovered another. That he sometimes became discouraged I know full well, for he often brought me his troubles. But he never gave up and he never acknowledged defeat.

Now in all this social endeavor where he tried to improve the approach to problems of a social, legal or educational character, his attitude was marked by an open-minded readiness to give every cause its day in court, but equally by a firm purpose to accept only those

whose vitality could survive the most drastic critical scrutiny to which he brought all the resources of a widely-read, well-informed, and extremely acute mind. He was an idealist in his aims and purposes, but a stern and unyielding realist in the means chosen to achieve these ends.

I regard his loss to psychology and to all the related social disciplines, whether theoretical or applied, as essentially irreparable. We have to my knowledge developed no one of his social breadth of vision and sympathy who enjoys at the same time a sound and thorough training in modern psychology, no one who is prepared to render just the service he was giving. The work he began will assuredly go on, for men will not let it perish; but we shall hardly find another to stand just where he stood.

EXPERIMENTAL STUDIES OF LEARNING AND THE HIGHER MENTAL PROCESSES IN INFRA-HUMAN PRIMATES

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Introduction

The use of infra-human primates as experimental material in research on psychological problems has increased markedly within the last decade. Indeed, statistical analysis shows that approximately 75% of the investigations in which these animals have been subjects fall within this brief period. While the facilities provided by the establishment of a special laboratory and breeding station for chimpanzees (**150**, **154**) have undoubtedly been a very large factor in this increase, there has also been a steady growth of interest in the use of the smaller monkeys.

The present review of the experimental studies on primates[1] has been limited to the problems of learning and the so-called higher mental processes. The very complete survey of the literature on anthropoid apes by Yerkes and Yerkes (**159**) renders unnecessary the inclusion here of many early observational reports as to the intelligence of these animals. An earlier review (**157**) of the studies of the behavior and mentality of the higher apes covers the period 1912 to 1926, and the volume on vertebrates of Warden, Jenkins and Warner's textbook (**138**) presents a comprehensive survey of the experimental studies of all primate types.

Discrimination Experiments

Because of our emphasis on the higher mental processes, studies which are concerned primarily with sensory and simple perceptual functions, such as color vision, sensory acuity, and form discrimination, have not been included in this review. We have confined ourselves entirely to investigations, by the discrimination method, of the learning process and such supposed higher perceptual processes as

[1] For convenience the term 'primate' will be used instead of the longer 'infra-human primate.' Except when indicated it is to be understood as not including man.

response to relations, abstraction, and generalization. As the distinction between higher and lower perceptual processes is a more or less arbitrary one, the selection of experiments to be included has likewise had to be arbitrary.

Discrimination Learning. Until recently the use of the discrimination method in animal experimentation was concerned, for the most part, with the study of the more simple sensory and perceptual processes. In so far as this method involves learning, however, certain more or less incidental information concerning the nature of this process was provided.

Thus the early experimental studies of Kinnaman (**58**), Shepherd (**104**), Watson (**140**), and Johnson (**52, 53**) with monkeys, and Köhler (**64, 66**) with chimpanzees, showed that these animals learned discrimination habits in much the same manner as the lower forms, such as the white rat, dog, and chicken. The presolution period was usually marked by a more or less prolonged series of repetitive errors and successes until finally the response was made consistently to the correct stimulus. Furthermore, these animals showed the same types of perseverative errors, *e.g.* position habits and alternation tendencies, as did the white rat, and the learning was usually, although not always, marked by a gradual improvement in accuracy of choice. Although comparisons of the rate of learning from one species to another are of little value because of the lack of comparability of types of apparatus employed, the results of these studies indicated that neither monkey nor chimpanzee was able to learn similar discrimination habits more quickly than the lower vertebrates. On the other hand, human children, especially those at the level of speech, show a marked superiority over all animals in discrimination learning (**27, 28, 66**). Their learning, it is interesting to note, was often accompanied by verbal responses.

While Köhler (**64, 70, 72**) has contrasted the type of mechanical, inattentive learning usually shown by the chimpanzee in discrimination training with the intelligent behavior it exhibits in the " insight " type of problem solution, he, nevertheless, expressed the opinion (**66**) that slow progress in discrimination learning was not so much a function of the rate of formation of associations, as it was due to the difficulty in discovering the relevant cue aspect of the situation. He emphasized the importance of making the cue stimulus stand out clearly and sharply in the field of vision, particularly at the time of making the choice, and suggested that if this could be arranged, the learning would be very brief, if not immediate. Köhler explained the occasional occurrences of sudden learning of the discrimination by his chimpanzee subjects as due to the happy fact that the animal chanced to note very clearly and strikingly the relevant stimulus structure at the time of making the response.

In contrast to this view of Köhler's, Spence (**109**) has recently offered a stimulus-response theory of the nature of discrimination learning in animals which places much more importance on the part played by associative processes. According to this theory, discrimination training involves the building up, in cumulative fashion, of the associative strength of the positive stimulus aspect with the approaching response, as compared with that of the negative stimulus, through selective reinforcements and frustrations (or punishments). In an investigation with adult chimpanzees, Spence (**110**) found experimental support for this theory in the fact that the learning of a series of discrimination problems involving various combinations of four different forms, was closely correlated with the relative number of reinforcements and non-reinforcements the stimuli had received in previous training, *i.e.* in previous discrimination problems. This result indicated that the cue stimulus was operative during the trials preceding solution as well as those at and after it. The animal did not respond exclusively to one particular sensory aspect, then to another, and so on until the correct one was hit upon.

In a further paper concerned with the same experimental data (**112**), Spence attempted to show how the occurrence of sudden, as well as gradual, solutions in learning discriminations may be accounted for in terms of a theory based on association principles. According to this theoretical analysis the following are some of the important factors determining whether the subject will learn the discrimination suddenly or gradually: (1) the extent to which variable stimulus factors are operative in the situation; (2) the excitatory or associative strengths of the cue stimuli (positive and negative) as the result of past experience; and (3) individual differences in the effects of reinforcements and non-reinforcements.

Klüver (**61**) and Nissen and McCulloch (**93–95**) have studied the effects of variations in certain stimulus arrangements on the rate of discrimination learning. Instead of the usual situation in which one positive and one negative stimulus are employed, these investigators presented the positive stimulus with a number of similar negative stimuli (from 3 to 11). While Klüver, working with monkeys, did not attempt any direct comparison of the 2 techniques, he obtained extremely rapid learning, in some instances almost immediate, under the non-equilibrated situation, or, as he termed it, the strata technique. Nissen and McCulloch found that a direct comparison of the 2 methods with chimpanzees showed a decided advantage for the non-equated or strata technique. The explanation given by both writers is in terms of the change in the figure-ground relationship of the situation. Instead of 2 figures on a ground, as in the paired situation, the positive stimulus in the strata method becomes a figure on the homogeneous, negative (ground) stimuli, and this

method takes advantage of the greater tendency on the part of an organism to respond to figure than ground.

Bierens de Haan and Meyknecht (10) distinguished between 2 types of learners in monkeys, a sensory and a motor type. The latter were less deliberate and showed strong tendencies to go from one position habit to another.

Response to Relations. The problem whether animals respond to the relative properties of a stimulus situation was first attacked in 1902 by Kinnaman (58) with the monkey as subject. Since that pioneer investigation this problem has been studied in several different stimulus dimensions. In vision, Johnson (52, 53), Bierens de Haan (5), Weigl (141), Kafka (54), Klüver (59, 61), Tellier (121), and Verlaine (126, 131, 133, 134) have studied the responses of monkeys to stimulus differences of size (area, height, width, distance, etc.), while Köhler (64, 66) and Spence (111) have worked on the problem with chimpanzees. The results of all of these investigations have shown a pronounced tendency for the response apparently to be to the relative characteristic of the situation rather than to the absolute.

However, under certain conditions, the "relational" response breaks down and the animal responds randomly or even to the absolute stimulus in the critical transposition tests. Kafka (54) and De Haan (5) found that the presence of the positive stimulus in the test pair lowered the proportion of "relational" responses. When altogether new and different sized stimuli were employed, the percentage of responses to the relationship was greater. Similarly, Köhler (66), Klüver (61), and Spence (111) showed that there was some tendency for the test combinations involving the negative stimulus and a new one to have a higher percentage of "relative" responses than those involving the positive stimulus. Opposed to the results of Kafka and De Haan, however, Klüver and Spence discovered that the number of relative responses decreased when the test stimuli differed considerably in size from the original training pair. Spence also found that his chimpanzee subjects did not respond to the relation "smaller" when still smaller stimuli were involved in the test combinations. On the other hand, the macaque monkeys of Tellier and Verlaine were able to respond consistently to the relation in this circumstance. The results of these investigators are somewhat unique not only in the marked extent to which the "relational" response predominated over the absolute, but also in the extraordinary ease with which their subjects learned the various

kinds of discrimination. Both, also, were able to train their subjects to respond to an absolute stimulus size, although with relatively greater difficulty (**121**, **126**, **131**, **133**, **134**).

The occurrence of relative and absolute responses in the discrimination of brightness differences has been studied by Kinnaman (**58**), De Haan (**5**), Klüver (**59**, **61**), Weigl (**141**), and Tellier (**121**) in the monkey, and in chimpanzee by Köhler (**66**). As in the case of size discrimination, response on the basis of relationship has tended to be dominant. Köhler found that his chimpanzee subjects responded to the brightness relationship a somewhat higher proportion of times than did his hens. Again, there was a marked tendency for the animal to respond "absolutely" when the positive stimulus of the training series was present in the test pair (transposition in the positive direction). De Haan (**5**) had one monkey, which had been trained to the darker of 2 stimuli, choose the same (absolute) stimulus 18 times out of 20 trials when it was presented with a still darker one. On the other hand, when presented with the negative training stimulus and a lighter one, it chose the former (relative) 19 out of 20 trials. Tellier found that her monkey could be trained to an absolute brightness (**121**).

The "relative" and "absolute" responses in color series have been investigated by Köhler (**66**) and Tellier (**121**). The former found that in a red-blue series, one of his chimpanzee subjects responded "relationally," *i.e.* to the redder, while another first chose "absolutely" and then in a second test given some time later, "relationally," when the transposition was in the positive direction. In a red-yellow series also, "relational" response was obtained. Tellier's results with macaques were not quite as conclusive as those of Köhler with chimpanzees. She concludes, however, that "relative" response undoubtedly precedes the "absolute." Training to the absolute color was also possible just as in the case of size and brightness.

A similar dominance of "relative" over "absolute" response has been found by Klüver (**60**, **61**) and Tellier (**119**) in the discrimination of weights. In the perception of roughness (tactual sensitivity), however, there was no marked difference between them (**116**). In concluding this resumé of the experimental findings on this problem, mention should be made of the fact that several investigators have demonstrated that the "relational" response, for example to size, is not disturbed by changing other characteristics of the stimulus, such as its form, brightness, or color (**61**, **121**, **126**, **131**, **141**).

The earliest interpretations (**52**, **58**) of this so-called "relational" response were inclined to emphasize its significance for the higher mental processes in animals. It was regarded as being of a higher type than response to "absolute" qualities and as involving the

definite experiencing or perception of an abstract relationship. Köhler (**66**, **69**), on the other hand, regards response to such relations as an elementary and natural form of reaction, and suggests the possibility that the "absolute" method of response is the higher achievement. Verlaine (**126**, **130**, **131**, **133**) is insistent that the response of the animal is not to a vague, syncretic whole, but involves an abstract analysis and appreciation of the elements and their relations. Klüver (**61**) has criticized the conclusions and interpretations that have been drawn concerning this phenomenon, because of the insufficient experimental data available for evaluating the many and complex factors which are operative. He pleads for a cautious "morpho-psychological" stand and suggests an empirical approach to the problem in terms of determining the limits of equivalence of stimulus situations. Spence (**111**), on the other hand, has proposed a rational approach to the problem in terms of stimulus-response concepts and conditioning or association principles. This theory attempts to define the conditions under which the 2 types of response, "relative" and "absolute," appear.

Abstraction and Generalization. Révész (**99**, **100**) first raised and experimentally investigated the question whether animals are capable of abstraction. His macaque monkeys were trained first to choose one of four different figures each of a different color. In a subsequent test experiment with 4 figures, one of which was like the chosen figure in form and another like it in color, the subject showed that it had been affected by both characteristics, the form and the color, with form being dominant. In other experiments he showed that the monkey recognizes the similarity between figures cut out of colored paper and linear figures of identical form. But the monkey failed, after being trained to react to an equilateral triangle, to recognize differently shaped triangles, which led Révész to conclude that his subjects did not cognize the figures on the basis of such an abstract concept as "triangularity," but that they merely reacted to similarities on a sensory plane. Bierens de Haan (**3**) failed to find any difference in the readiness with which his monkeys "abstracted" form or color, while Kohts (**75**, **77**), employing the "choice from sample" method devised by her, found that her chimpanzee was able to select most successfully an object similar to the sample in only one respect in the case of color. The subject encountered considerable difficulty in making such abstractions.

Gellermann (**27, 28**) working with chimpanzees, and Neet (**89**) with monkeys, have shown that the discrimination of triangles by these subjects is not affected by rotations of the figure, by changes in the type of triangle, by changes in the relative size, or by changes in the background. Gellermann's studies revealed that children were definitely superior to the chimpanzees in satisfying the criterion of ability to discriminate form (triangularity) *per se*. This superiority was associated in part with the utilization of verbal behavior by the children. Both investigators suggest that the response may be under the control of some symbolic process.

The most extensive recent studies of this problem are those of Tellier (**115, 116, 118, 120**) in the field of tactual and visual perception, and Verlaine (**127–135**) on visual perception in monkeys. In the experiments on visual perception the former studied the ability of the monkey (*Macacus sinicus* and *rhesus*) to discriminate circles, triangles, and parallelograms which varied in structure, color, or orientation from other forms presented; equilateral from non-equilateral triangles; a cubical, spherical, or prismatic object as opposed to volumes of other type; an acute angle from a variable obtuse angle; a cross of variable dimensions from other objects; the number of dots on cards; an oblique line from vertical and horizontal ones; pictures of different animals from pictures of plants; and quadrupeds from a biped. All of Tellier's subjects learned to make the correct response after more or less training, thus showing that they were able to appreciate and guide themselves by the common properties of objects which are more or less similar to each other. Tellier concluded further that in such discriminations the monkey responds, from the beginning, to the more general characteristics of objects rather than to the particular. Generalization is primordial in the perceptual activities of the monkey.

Verlaine carried out an extended series of investigations on the perceptual processes of the monkey. He was particularly interested in demonstrating, not only the primordial rôle of generalization in animals, but also the fact that they do not respond on the basis of vague, total impressions or, as he termed them, syncretic perceptions, but that they are capable of genuine abstraction, which involves the ability to analyze and synthesize the object into its various constituent elements. He found that the monkey was able to discriminate successfully between distinguishing parts of a triangle and parts of other forms (analysis), and also that it was capable of recognizing various forms and things from their fragments (synthesis). Verlaine concluded from his investigations that the behavior of his monkeys

indicated the presence of higher mental processes that are singularly like those which in human subjects are called abstraction.

The main contribution of the above studies to our understanding of primate behavior is the fact that these animals are able to discriminate or respond selectively to very limited and particular aspects, or partial constituents, of the total stimulus object. Whether or not one wishes to characterize such a performance as abstraction depends upon the definition one gives of this process. In the sense of the ability to respond to partial contents of the stimulus, almost all of our discrimination experiments involve abstraction, and from this point of view there would be no difference between the discrimination of size and the response to form *per se*.

As to the claim that such performances indicate the occurrence of higher mental processes involving the operation of abstract concepts or ideas, it is the opinion of the present writer that the facts may be quite adequately accounted for in terms of simple sensory analysis and association or conditioning. That is, through selective training, the particular, limited aspect of the stimulus object or sensory pattern, *e.g.* that which distinguishes triangles from all other geometrical forms, is always systematically reinforced, whereas other characteristics are not, as their occurrence is either never followed by reinforcement, or they receive both reinforcement and non-reinforcement. This particular aspect thus acquires a greater excitatory value (stronger associative connection) than the other components, which gives all sensory patterns containing it a relative advantage in excitatory strength. According to such a view the limitations placed upon this abstraction ability are not determined by any higher mental capacities but by the sensory capacities of the organism.

In concluding this section mention should be made of two further studies which indicate the extent to which primates are able to abstract or respond to particular aspects of the stimulus situation.

Robinson (**101**) succeeded in training a monkey to respond always to the odd box of 3, the one differing in brightness from the other two. Nissen and McCulloch (**95**) found that their chimpanzee subjects also showed a very marked initial tendency, more pronounced with color than with pattern stimuli, to respond to the odd stimulus. This initial response to oddity would appear to be much more adequately explained in terms of stimulus properties, *i.e.* the figure-ground advantage of the odd stimulus, than in terms of some higher process of abstraction. In this connection it is interesting to note that a considerably greater amount of training was required for the response to be learned in Robinson's set up than in the more unequilibrated situations employed by Nissen and McCulloch.

Conditioned Response Studies

The conditioned reflex technique has been used with primates, as with other groups of animals, in studies of sensory capacities, investigations of the effects of destruction to various portions of the brain, and in experiments on the nature of the conditioning process itself. The number of primate studies employing this method has been relatively small, largely because of the difficulties of using many of the special techniques that have previously been developed with other animals. Neither salivary fistulas nor the use of shock to produce a withdrawal response are particularly well suited to the primate's temperament or other response characteristics.

Nevertheless, a few investigators have either found some of the already existing reflex methods, *e.g.* eyelid reflex, feasible with primates, or have been able to employ modifications of them. Elder (**19**) and Wendt (**142, 143**) conditioned their subjects to make certain food getting responses to auditory stimuli. The former trained chimpanzees to depress a key on hearing a tone, and the latter had monkeys pull open a door. Both investigators found the conditioned reflex method highly satisfactory for the determination of sensory limens.

Marquis and Hilgard (**85**) and Starikov (**114**) have investigated the effects of destruction of cortical areas of the brain both on existing conditioned reflexes and the capacity to form them. The former found that bilateral removal of the occipital lobes did not affect the establishment of a conditioned eyelid response to a light stimulus in 3 rhesus monkeys. The rate of formation of the conditioned response, its form, amplitude, and frequency were essentially similar in normal and operated subjects. Only in latency was there a significant difference. When the operation was performed following conditioning, 1 of the 3 subjects showed post-operative retention. The other 2 did not, but readily responded with further training. Starikov similarly obtained post-operative retention by 3 monkeys of auditory CR's (including a differential response to the number of beats of a metronome) following bilateral extirpation of cortical areas 17, 18, and 19. Differential and conditioned responses to color stimuli, on the other hand, were not retained and, moreover, could not be reacquired a year later in 150 trials.

Investigations of the various characteristics or properties of conditioned responses in monkeys and apes have indicated that they are essentially similar to those found by Pavlov in the dog and by

other investigators in human subjects. Several Russian experimenters have made comparisons of the behavior of anthropoids and monkeys. Dolin (**17**) reported that inhibitory processes are more highly developed in the chimpanzee than in the rhesus monkey. Majorov (**83**, **84**) found that comparisons of the formation of conditioned reflexes in anthropoid apes and monkeys indicated that positive conditioning, and such negative processes as are involved in extinctive, conditioned, and delayed inhibition, developed more quickly in the former. However, the data of Lindberg (**82**) on the inhibition of motor feeding conditioned reflexes of 3 monkeys, an orang, and a chimpanzee did not evidence such species differences. There were individual differences, but they were interpreted as probably related to age and sex factors.

Hilgard and Marquis (**41**) have pointed out the difficulties in making such comparisons as the rate at which conditioned responses are formed or extinguished. They found that even under highly similar experimental conditions the nature of the reflex response differed for the dog, monkey, and man in a manner that seriously limited such inferences. Certain functional comparisons, however, revealed: (1) that the acquisition of conditioned responses tends to follow a similar double-inflection curve for dog, monkey, and man; (2) that, whereas extinction was rapid in man and dog, it practically never developed in their monkeys; (3) that retention was uniformly good for all 3 groups of subjects; and (4) that each group exhibited a gradual decrease in latency of response as the conditioning proceeded.

Secondary Problem Solutions: Trial and Error Learning

Nellmann and Trendelenburg (**90**) have made a very useful distinction between 2 types of problem solutions, primary and secondary. A secondary solution is one which involves a preceding learning process, either learning by imitation, by trial and error, or by tuition. A primary solution, on the other hand, is one in which a novel problem is successfully solved without any overt learning process, but as the result of an immediate understanding or insight into the situation. Köhler and the Gestalt psychologists have concerned themselves largely with the latter type of problem, while the American psychologists have tended to favor the study of the method of secondary solution. In the present section the experimental studies of the trial and error method of problem solution are reviewed. For

the most part they have employed 2 general types of apparatus, the problem or puzzle box and the maze.

Problem-Box Learning. The earliest extensive experimental investigation of this problem in primates was carried out by Thorndike with 3 cebus monkeys (122). Thorndike's major interest was in ascertaining whether these animals employed rational methods or learned by "trial-and-accidental-success." He employed a variety of simple and combination problem-box devices similar to those he had previously used with cats and dogs. While results showed the monkey to be somewhat superior to the cat and dog, Thorndike nevertheless concluded that its learning was of the trial and error type and did not show any evidence of reasoning or the operation of ideas. The more rapid, and in some instances, sudden learning, demonstrated by the monkey, was explained as being due to a combination of factors, its superior sensory and motor capacities and possibly a faster rate of formation of simple associations.

Kinnaman (**58**), Shepherd (**104, 106**), and Kohts (**76, 78**) likewise found that the rhesus monkey employed a trial and error method of learning in solving such problem situations, although some of the very simple devices were learned almost immediately. They reported that the behavior of the animal was usually characterized by a general and random scrambling about, which, following a few successes, became centered or directed more and more around the locus of the final, successful act. Kohts emphasized the fact that the monkey frequently picked at the lid of the box before it was unlocked as evidence of the blindness of its behavior. Buytendijk (**15**) found that a cercopithecus monkey had first to be trained to open a box by means of depressing a lever, and that it learned to adjust to various complications of the situation only by trial and error procedure. Boutan (**13**) concluded that his female gibbon had no understanding of the movement required to open the box, although he claimed it did have prevision of the end to be attained.

The results of these studies are very nicely corroborated by the experiments of Nellmann and Trendelenburg (**90**) and Drescher and Trendelenburg (**18**), who investigated the capacities of several types of monkeys, chimpanzees and orang-utans to make primary solutions without overt trial and error learning in simple problem-box situations. When presented with a box fastened by a bolt, 2 of the monkeys (Java and Pavian) failed to solve the problem even after a considerable amount of trial and error behavior, while a rhesus monkey and a gibbon succeeded, not by means of primary solution, but by learning. In a similar manner, that is by learning, the gibbon and the rhesus were successful with a two- and three-bolt box, the latter even learning to open

the box by pushing the bolt away from him. The orangs responded only slightly, if any, better than the rhesus monkey, but the chimpanzees were much more successful. In fact, one showed primary solution even when the bolt was in the position which required a movement away from her. Yerkes (**151, 152**) has reported that the gorilla, Congo, learned to open boxes fastened with an unlocked padlock and a spring snap only after a considerable amount of random trial and error activity.

Frankly recognizing the problem-box technique as a device for measuring learning ability, the Jenkins problem box was developed as an attempt to provide a standardized method which would present a series of problems of graded difficulty. This apparatus has been used with several kinds of animals, including 2 different types of monkeys. Fjeld (**21**) used the rhesus monkey and Koch (**63**) the cebus. Both studies were carried out under excellently controlled conditions and involved the use of fairly large numbers of subjects. From the point of view of analysis of the nature of the learning process, the method has proved somewhat disappointing. However, it has provided a fairly satisfactory instrument for comparing the limits of learning capacity of different animals. Measured in terms of the number of steps learned, the average scores for various animals were found to be as follows: cebus monkey, 9.8; rhesus monkey, 7.4; kitten, 3.6; rat, 0.9; and guinea pig, 0.5. Incidentally, little correlation was found between the number of steps learned and the speed with which they were learned.

In an attempt to ascertain whether primates, like white rats, behave in accordance with the *principle of the minimum path* in problems involving alternative solutions of unequal distance or difficulty, Gengerelli (**29**) presented 4 South American ringtail monkeys with a problem box which required the depressing of several levers to obtain access to food. The not altogether conclusive nature of the results is probably best indicated by the investigator's own statement that "the pattern (of response) finally fixated is not necessarily the pattern which involves the smallest possible amount of physical work in that situation, but it is invariably a pattern which is in the vicinity of that limit" (**29**). Fischel (**20**) employed a method similar to the Skinner type of problem box with which he studied the learning of monkeys. Here, too, the responses to the lever were acquired by trial and error.

A number of investigators, Franz (**23**), Lashley (**81**), and Jacobsen (**43–47**), have studied in monkeys the relation of certain cerebral functions to the retention and acquisition of problem-box solutions. These experiments have indicated that such responses are not affected by lesions (frontal areas) which do impair adaptation to more complex problems (cf. delayed reaction, p. 839). The solutions of all the problem boxes in these experiments, whether simple

or combination ones, were marked by much random trial and error activity.

Serial or Maze Learning. The maze method, exploited to such a great extent in experimentation with the white rat, has not been popular with investigators of primate behavior. In fact, Kinnaman's early study (**58**) remains the only investigation of maze learning of monkeys. He employed a modified Hampton court pattern and found that his 2 rhesus monkeys required 66 and 113 trials to learn. Attempted comparisons of the learning of a white rat and the monkeys indicated little difference in the rate or method of learning. Unfortunately, the irregular pattern of this maze does not provide satisfactory data on the interesting question of whether the order of learning of the blind alleys by monkeys is backward, like that of the white rat, a primacy-recency one similar to that exhibited by human adults, or in between these two as the results for very young children tend to be.

Spragg (**113**), and Jacobsen, Wolfe and Jackson (**51**) have investigated the displacement (anticipation and perseveration) of responses in the learning of certain serial tasks by chimpanzees. Spragg, employing spatial and temporal stylus mazes, found that his subjects exhibited a gradient of anticipatory responses similar to those shown by the white rat and human subjects, the anticipations being greatest near the point of the final, critical response. Extended training tended to reduce the number of anticipations and increase the frequency of perseveration responses, a characteristic in which the chimpanzees were more like the human subjects than white rats. The temporal maze, with its lack of supporting spatial cues, proved very difficult for the chimpanzee and was productive of an even greater number of maladaptive anticipations than the spatial maze.

The study of Jacobsen, Wolfe, and Jackson (**51**) is particularly important in demonstrating a possible correlation between inhibition of such anticipatory tendencies and the functioning of the frontal association areas. A chimpanzee which had been trained in a serial problem to push three pegs and pull the fourth to obtain food, at first showed a considerable tendency to anticipate the final, pulling response. Following the learning, in which this tendency was eliminated, bilateral extirpation of the frontal areas resulted in a reappearance of the anticipation of the direction of the final movement. Within the limits of postoperative reëducation, the number of these responses actually increased rather than decreased.

SECONDARY PROBLEM SOLUTIONS: IMITATIONAL LEARNING

The term imitation has been used in a number of different senses by writers in comparative psychology. Usually different levels or grades are distinguished, such as pseudo-imitation or mimicry, instinctive imitation, and intelligent or inferential imitation. Experimental investigations of the problem have been concerned for the most part with attempts to demonstrate the occurrence in animals of the highest form, intelligent imitation. Almost without exception these experiments have presented the animal with some type of problem situation in which, however, instead of requiring the animal to solve the problem by itself, it is first presented with an opportunity of observing another subject perform the correct, adaptive response. To the extent that the animal is able to profit from this observational experience when it is itself confronted with the problem, it is said to have exhibited imitation or learned by imitation. Evidence of such an ability is shown either by an immediate solution of the problem, in which there is a more or less exact reproduction of the observed act, or a saving in the amount of time required over adaptations achieved by trial and error.

The early investigators of the mental processes of primates were considerably interested in the problem of imitation and usually included it among the objectives of their studies. Thorndike (**122**) reported a series of experiments on problem boxes with a cebus monkey which produced negative results both when the imitatee was the experimenter and when the imitatee was another animal. Watson (**139**) likewise failed to have any of his 4 monkeys learn various problem situations by imitation. On the other hand, Hobhouse (**42**) and Kinnaman (**58**) obtained positive evidence of imitation, although their results were not altogether convincing, as the subjects had experienced considerable previous practice on the problems.

The first extensive investigation of imitation in primates was that of Haggerty (**34**) who used 11 monkeys (cebus and macacus) on comparatively simple devices specially adapted to the manipulative abilities of the animals. Each subject was given 5 preliminary trials on a problem and those who failed were then given an opportunity to learn by imitation. Haggerty reported 16 cases of successful imitation, 5 partially successful, and 5 failures. Actually there were only 5 cases of successful learning in the *first* ten-minute imitation test following demonstration.

Shepherd (**104**) failed to observe imitation in 8 monkeys in a problem which required poking a piece of food out of a glass tube. In a second test, involving the use of a rake to draw in food, 2 of

the 8 subjects showed some evidence of imitation after several days of testing. The results of similar tests on an orang and chimpanzee were entirely negative (**105, 107**). Kempf's rhesus monkeys showed surprisingly little aptitude for imitating such a simple act as reaching through a small aperture in the cage wall to obtain food from a box (**57**). Similarly there are a number of incidental observations indicating the difficulty of eliciting imitative behavior in monkey (**15, 76, 79, 146**), orang (**149**) and gorilla (**151, 152**).

The main criticisms that may be leveled at these early studies of imitation can be most briefly indicated by an enumeration of the 5 criteria of intelligent imitation that Warden and Jackson (**137**) attempted to meet in their recent important experiment on this problem, and which few of the early studies had satisfied even to a small degree: "(a) the task must be novel and sufficiently complex, (b) the response must appear immediately after observing the imitatee, (c) practice must be excluded by the experimental conditions, (d) the act of the imitator must be substantially identical with that of the imitatee, and (e) a sufficient number of instances must occur, under varied conditions, to eliminate the chance factor" (**137**, p. 104).

In order to meet these rigorous criteria Warden found it necessary to devise and employ a new technique. The apparatus consisted of 2 identical and adjacent cages each of which contained a duplicate puzzle box. The experimental procedure consisted, first, in illuminating the puzzle device of the imitatee by a spotlight while he performed a number of demonstration trials. When the imitation test was to be given, the light was turned off in the imitatee's compartment and flashed on in the other compartment, and at the same time the imitator was released from a restraining chain and permitted 60 seconds in which to solve the problem as observed.

Despite the more exacting criteria, the results of this experiment revealed that 15 rhesus monkeys showed immediate imitation in 46.3% of the 354 tests which were given (6 tests on each of 4 different problems). Complete failure to learn by imitation was obtained in 24.6% of the tests, while partial imitation was exhibited in 29.1% of them. The authors explain the relatively greater positive character of their results in part as due to the advantages of their new type of apparatus, which did not involve the usual delay and distraction between observation and imitation that the older techniques did, and in part as due to the use of tamer and better adjusted laboratory animals.

The interpretations of imitative behavior have varied from the one extreme that it is a rational process, in which an animal, per-

ceiving an act of another animal and its results, realizes or understands these consequences and thereupon performs a similar act in order to obtain the same results, to the opposite point of view that imitation represents merely an abridgment of the learning process as the result of a change in the stimulus conditions, or more specifically that it is the result of the enhancement of the particular limited aspect of the total stimulus situation to which the response is to be made. In the writer's opinion none of the experiments on imitation, including that of Warden and Jackson, has sufficiently ruled out this factor of the enhancement of the stimulus. The solution of simple problem-box situations depends to a very large degree on the process of selection of the relevant, limited aspect of the situation. In most problem boxes the relation between this stimulus aspect and the goal object is not apparent, and it is only as the result of chance that a response is made to it. Once hit upon, however, the process of learning or association may be very brief. Any factor, then, that favors an early chance response to the cue aspect of the stimulus situation will expedite the solution. The response of the imitatee to a particular part of the apparatus has the effect of limiting the responses of the imitator to this region, with the result that the probability of hitting upon it is greatly increased. Furthermore, the presence and sight of the food undoubtedly stimulate the imitator to greater activity, which is another important factor hastening the first success in problem-box learning.

As for the particular nature of the act made by the imitator, its similarity or identity to that of the imitatee does not require explanation in terms of a copying of the pattern set by the imitatee. This required act is usually a very simple one which is called out naturally by the particular stimulus characteristic, because of the latter's similarity to other stimuli with which the response has previously been connected or associated. In confirmation of this point is the fact that imitation occurs only when the required reaction is already a part of the organism's response repertoire. Thus, monkeys have consistently failed to learn by imitation such performances as using a stick to push food out of a glass tube.

Several recent studies have emphasized various social aspects of the problem of imitation in primates. The investigation of Aronovitch and Chotin (**1**, **2**) is interesting from the point of view of both method and problem. A single dominant monkey and a group of 3 others were given opposed training. The former was trained to open a food box when light A was present and not when light B was

present, while the group of 3 were trained in the reverse manner. The subjects were then all placed in the same cage and the conflict between their learned behavior and the opposed social example observed. It was found that the average amount of imitation was 25%, and furthermore, that the individual animal imitated the group more than he influenced them.

Yerkes (**155**) investigated the problem of social facilitation as exhibited in the tendency of the chimpanzee to chew a piece of filter paper at the example of the experimenter. Employing a rating scale to measure the behavior of his subjects, he found definite evidence of extra-species suggestibility, which varied with age, the sexual status of the animal, and the intimacy of the social relationship between the subject and the experimenter. The same investigator (**156**) also reported facilitation of response through social stimulation in multiple-choice problems in which 2 subjects were worked simultaneously. There was no evidence, however, that the behavior of the leader influenced the follower in the selection of the correct box.

Crawford (**16**) recently reported an investigation of coöperative behavior in the learning of problem situations by chimpanzees. He discovered that his subjects, at first, were quite unsuccessful in coördinating their efforts, and that it was necessary to condition them to respond simultaneously, but independently, to a verbal command of the experimenter. Subsequently the animals became independent of this stimulus and learned to watch their partner and to time their response with his. A third stage, which was attained by 2 subjects, was that of soliciting the partner for help when he was not working. Probably one of the most significant findings of this experiment was that the coöperative solution was not arrived at by any process of insight, but by a special training procedure based on simple association principles.

Primary Problem Solutions: Insightful or Intelligent Behavior

The basic design of the variety of problem methods used to study insightful or intelligent behavior involves the presentation of a novel situation to the animal, in which the direct approach to a reward is blocked, but an indirect way is left open. The arrangement of the problem is always such that its various parts, and the relations that exist between them, are clearly visible to the subject, and it is in this respect that it differs most from the problem-box type. The solution of such problems, independent of any previous experience

or training with the essential relationship involved, is taken as evidence of behavior with insight or understanding.

Köhler, whose experiments on chimpanzees have become widely known through his various articles and books (**65**, **67**, **68**, **69**, **73**, **74**), is largely responsible for the development and popularity of this approach, although he was preceded in its use by Hobhouse (**42**), who originated and used with success many of the specific situations, Watson (**139**), who employed several tests of this type with negative results in his study of imitation in monkeys, and Shepherd (**104**, **105**, **106**), who attempted to investigate ideation and reasoning in various monkeys and anthropoids. Köhler's own experiments may be grouped into 4 types: (1) The use of an object (string, stick, box) as implement to obtain the lure; (2) roundabout methods including indirection in use of tool (pushing food around barrier); (3) the fabrication of implements (stick-joining, box-stacking); (4) problems involving intermediate objectives or sub-goals (multiple sticks). All required for their solution the perception of some important relationship. Köhler proceeded systematically, presenting simpler problems first and, later, depending upon the ability of the individual subject, more complicated tests.

While there were marked differences in the capacities of the individual subjects, the results of these experiments showed that the chimpanzee was able to solve most of them. In his interpretations Köhler emphasized the fact that the successful adaptations were such as to make explanations in terms of chance very improbable, and he concluded that the chimpanzee is capable of behaving intelligently and with insight when confronted with such novel situations.

Since Köhler's investigation some score or more of experiments have been carried out with these methods on both monkeys and anthropoid apes. Unfortunately few attempts have been made to standardize methodology [2] or experimental material, so it is a difficult and hazardous matter to make comparisons and draw any definite conclusions. In fact, one gains the impression that the investigators in this field have vied with each other in an attempt to provide more

[2] The criteria which differentiate an insightful solution from one which is attained with more or less trial and error effort are particularly variable from one experimenter to another, and, in some instances, not too rigid. The writer often found descriptions of behavior which seemed to him to represent excellent examples of so-called trial and error behavior, only to find the conclusion of the experimenter was that the solution was undoubtedly not of this type, but an achievement of insight.

and more novel variations in the test problems. Where such variations are for purposes of studying the underlying mechanisms of behavior, they are, of course, entirely justified. All too frequently, however, the motive seems to have been merely that of seeing what the animal could do! From this latter point of view isolated performances are of small worth.

Nevertheless, certain forms of tests have been used to a considerable extent by different investigators and with a variety of subjects. Furthermore, there are a few studies which have extended certain of the problems more or less systematically.

Use of Objects as Implements to Obtain Lure. In the simplest form of this problem the lure is attached to a string, stick, or board, one end of which is within the animal's reach. Sometimes the food is visible and sometimes it is placed in a box which is attached to the intermediate object. The results of various studies in which some variety of this test has been used indicate quite generally that it is readily solved both by monkeys and the higher apes (**7, 18, 30, 32, 40, 61, 62, 65, 90, 105, 136, 151**). The experiments of Kuroda (**79**) and Watson (**139**) with monkeys were not quite so positive.

Guillaume and Meyerson (**32**) have shown that their subjects, including monkeys, a gibbon, and one or more of each of the anthropoid apes, were not deterred from pulling the string when the food did not begin to move immediately or even when it moved temporarily in the opposite direction. These investigators carried out a large number of experiments involving more or less complicated arrangements of strings and sticks to which the food was attached. In most of the situations all except the brightest of the chimpanzees failed. Bingham (**12**) used a novel arrangement of this type of problem in which the subject had to transport the lure to an opening at the side and bottom of a large square cage by manipulating a knob along a channel on the top of the cage. Any one of 4 goal positions might be used and the animal was required to respond selectively to the appropriate goal. Bingham claimed that his young chimpanzee subjects exhibited evidences of ideational behavior in their adjustments to the various problems.

When the lure is not directly attached to the object, the problem is more difficult. With the exception of the cebus, the monkeys tested (rhesus, pavian, Java, spider, squirrel, and lemurs) have usually failed to use or understand the use of a stick to draw in food (**8, 15, 18, 33, 61, 79, 90, 104, 144, 149**). Similarly, the gibbon has shown little aptitude in this situation (**18, 33**). Buytendijk (**15**) and Nell-

mann and Trendelenburg (**90**) have shown that if the end of a rake is properly placed directly behind the food, the monkey is able to draw it in. The monkey failed, however, to reach out itself with the rake and place it behind the food. Klüver (**61, 62**) and Bierens de Haan (**8**), on the other hand, have discovered the cebus monkey to be quite able at solving such tool problems. And Verlaine and Gallis (**136**), somewhat contrary to the results of other investigations, found that their macaque monkey was capable of at least learning to use a stick. On the whole, however, the data strongly suggest a marked superiority of the cebus over other monkeys. Indeed, their performance approaches and even exceeds that of some of the higher apes.

The results for the anthropoid apes are not quite so clear cut. Yerkes (**149**) reported an immediate solution of the stick problem by the orang Julius, but pointed out that the possibility of imitation of man could not be excluded. Sheak (**103**) and Drescher and Trendelenburg (**18**) also obtained positive results with the orang, but Guillaume and Meyerson's (**33**) young subject failed in some brief tests. Positive results have generally been obtained in simple drawing-in stick tests with the adult chimpanzee (**18, 33, 35, 65, 68, 74**), although individual subjects occasionally fail. Age is apparently an important factor conditioning the success of chimpanzees, as very young subjects (under 3 years) either fail (**158**) or perform with hesitancy and considerable confusion (**33**). Kellogg and Kellogg (**56**) found that considerable tuition was required before their 15-months-old human subject and 12½-months-old chimpanzee were able to draw in food with a hoe except when the food was placed directly in front of the hoe blade.

Yerkes' (**151**) gorilla failed in the first stick tests, but learned to draw in food after tuition and some accidental successes. The gorilla subject of Guillaume and Meyerson (**33**) likewise showed a questionable performance as far as understanding is concerned. In many of these experiments it is difficult to distinguish what part learning plays in the successful performance, and, of course, there is little or no information as to the part it has played in the past experience of the animal.

In another form of test, the object is an obstacle or barrier which the subject must move to obtain the food. The removal of such obstacles has proved remarkably easy for monkeys (**18, 35, 42, 61, 62, 90**), whereas Köhler (**65**) found that the chimpanzee required a considerable amount of time to solve this type of problem. Yerkes' gorilla failed altogether (**151**). The gorilla also failed, at first, to free a chain which was caught around a stump (**151**), but solved the

problem a year later (**152**). Monkeys have adapted readily to the latter type of obstacle (**6, 42, 88**).

Various other tests which have demonstrated the ability of primates to use objects as a means to attain a distant goal have involved the climbing of ropes and doors, pole jumping, and the placing of stools or boxes under the lure. The latter test will be discussed later in connection with box-stacking.

Roundabout Methods Including Indirection in Use of Implement. One of the simplest tests of indirection is the diagonal cord test, in which the food is fastened in the middle of a cord secured at its far end and stretched diagonally in front of the working cage. The animal, working through the bars, is required to take the string from one end of the cage to the other in order to obtain the food. Monkeys (**18, 32, 90, 136**), orangs (**18, 32**), chimpanzees (**18, 32, 65, 74**), and a gorilla (**151**) have usually succeeded in solving this problem with varying degrees of ease and quickness, although there have been individual instances of failure even among chimpanzees (**74**), while 2 gibbons failed completely (**18, 32**).

Detours with a stick which involve the guiding of food away from the subject or at right angles around a barrier are all but impossible for monkeys, according to the results of Guillaume and Meyerson (**31**). In fact only one of their chimpanzee subjects had any degree of success with this problem. Köhler (**65, 74**) evidently had more favorable experimental conditions, for all of his chimpanzees were successful in the right-angle (90°) problem; several also succeeded in the more difficult 180° problem, which required the lure to be pushed directly away. Guillaume and Meyerson (**31**) carried out similar detour problems which did not involve the use of a stick, but required the animal to get the food out of a box by poking its fingers through a wire mesh and moving the food to the free end of the box. Only 1 of the 4 chimpanzees showed immediate success when the box opening was away from them. Two eventually learned after first being worked on the problem in which the food had to be moved at right angles, while the fourth chimpanzee failed altogether. One orang, and 1 monkey of 4, succeeded in getting food when the box opened to the left, but failed on the more difficult problem. The macaque monkey of Verlaine and Gallis (**136**) was able to obtain food when the detour was at an angle of 90° but failed in the 180° problem. They believed this to be due to the difficulty the monkey has in making the reaching out movement rather than its inability to understand the situation. Klüver (**61, 62**),

likewise, found that a 180° detour problem involving a stick was beyond the capacity of his cebus monkey. Yerkes' gorilla failed in 3 thirty-minute tests (**153**). The chimpanzee seems to be definitely superior to the other primates in this test.

A type of detour problem which has been used extensively is the stick and tube test. The food is placed in some form of tube, such as a pipe, glass tube, or elongated, narrow box, and the subject is required to push it out through the opposite end by means of a stick or rod.

Hobhouse (**42**), Nellmann and Trendelenburg (**90**), Shepherd (**104**), Watson (**139**), and Yerkes (**149**) obtained negative results with their monkey subjects in this problem. Klüver (**61, 62**) found that his cebus monkey, which was familiar with the use of a stick as a tool, was successful to some degree. Many of its solutions, however, were gained by pulling the food towards it rather than by poking it out of the opposite end. Buytendijk (**15**) and Verlaine and Gallis (**136**) were able to teach their monkeys to perform successfully after giving them considerable training. Yerkes (**151, 152**), likewise, finally succeeded after a long period of tuition in getting the gorilla, Congo, to obtain food in the box and pole arrangement of the situation. She had failed to solve the problem by her own initiative, or to learn by imitating the experimenter. The orang studied by Yerkes (**149**) mastered the problem in a manner which suggested to the experimenter that the animal might be acting ideationally. Two chimpanzees have been reported as solving the problem (**35**), but the infant subject of Yerkes and Learned (**158**) was unsuccessful in some brief tests.

Fabrication of Implements. The making of an implement has been defined by Köhler (**74**) as the treatment or modification of an object, which does not for the moment fit the situation, in such a way that it may be utilized to obtain the lure. Köhler (**74**) describes instances of successful fabrication of tools by chimpanzees, such as breaking off a branch from a tree and a splinter of wood from a box, the loosening of an iron bar, the doubling and shortening of straws in order, presumably, to increase their rigidity, the removal of heavy stones from a box, the uncoiling of ropes, and the joining of 2 short sticks to make a long one. Guillaume and Meyerson (**33**) have also described a few cases in which a chimpanzee has thus modified objects.

While examples of such tool-making by monkeys are not so numerous as in the case of chimpanzee, a few instances have been reported.

Verlaine and Gallis (**136**), after training their macaque monkey to open a box with a nail, found that it made use of a variety of other objects, even breaking off branches of a dried plant, and bending the fiber of a broom into a position in which it could be used. Klüver (**61, 62**) has reported that his

cebus monkey manipulated a piece of paper into a shape stiff enough to rake in food, and also that it broke off and used a stick which had been nailed by a staple to a table.

One of the most extensively used tests of tool fabrication has required the animal to stack two or more boxes in order to reach a suspended lure. This problem has proved to be an extremely difficult one for the lower primates.

While several studies (42, 61, 62, 102, 136, 149) have reported that the monkey would move or place a single box or stool under a lure, others found that their subjects made no attempt to use a box in this manner (79, 104), or never attained complete success (90). Only one investigation, that of Bierens de Haan (8), has obtained positive evidence of box-stacking. A cebus monkey, who had previously used a single box, succeeded after a few trials in stacking one box on another. When 3 boxes were required, 2 being placed under the food and the third on the floor, it succeeded immediately. Later this animal learned to stack 3 boxes, each of which was placed in a different corner of the cage. The author concluded that this animal's performance compares favorably with those of chimpanzees.

Among the higher primates Köhler (74), Yerkes and Learned (158), and Bingham (11) have reported the successful solution of various box-stacking problems by chimpanzees. Some of Köhler's subjects and 2 of the 4 used by Bingham learned to stack as many as 4 boxes to obtain the lure. Bingham extended the work of Köhler by improving and standardizing the experimental conditions. For the most part these studies have shown that the initial solution was not immediate, but occurred only after a series of more or less ineffective attempts to reach the lure by other methods. Bingham's study revealed the importance of the past experience of the animal in handling boxes. However, each of these investigators has emphasized the suddenness of the shift to the correct stacking solution and has offered varied evidence in support of its insightful or ideational character.

Although it did not involve stacking of objects, the study of Kellogg and Kellogg (56) provides interesting comparative data upon a chimpanzee (14½ months) and a human infant (17 months) learning to obtain suspended food by means of a chair. The former not only solved the problem in fewer periods of work but also adapted more readily to variations in the placement of the chair with respect to the lure. The adjustment of the human child was described as a mechanical, motor one while that of the chimpanzee was perceptual.

While the orang (149) and gorilla (151, 152) were somewhat slower and less resourceful than the chimpanzee in adapting to the box-stacking situation, both eventually were able to build and use three-box towers. The orang solved the two-box problem only after demonstrations by the experimenter,

whereas the gorilla, who had failed to solve the single-box problem independently, learned the two-box problem by its own initiative. Transfer from the two-box to the three- and four-box problems was relatively small in the case of the gorilla.

Problems Involving Intermediate Objectives or Sub-Goals. In this type of problem the subject has first to draw into the situation a second object which can be used to obtain the lure. Thus Köhler's chimpanzees were able to drag in a long stick by means of a short one, and then use the long stick to obtain the food. Similarly his subjects were successful in solving a problem which first involved placing a box under a suspended stick, climbing up and getting the stick, and then using it to draw in the food (**74**). Klüver (**61, 62**) has reported successful solutions of these same types of problems by his cebus monkey.

Guillaume and Meyerson (**33**) presented one of their chimpanzee subjects with 2 sticks, a short one and a long one, outside of his cage, and another short stick within the cage. Food was beyond the sticks and could be reached only by the longer one. Each time the animal drew in the long stick. Jacobsen, Wolfe, and Jackson (**51**) reported the successful solution by 2 chimpanzee subjects of tasks which involved as many as 5 sticks of graded sizes. The sticks were arranged on either 1 or 2 platforms in such a fashion that the nearest stick could be used to draw in a slightly longer one, which in turn could be used to secure the third stick and so on until the last one, which could be used to obtain the food, was secured. When the sticks were on a single platform, neither unilateral nor bilateral extirpation of the frontal areas affected the solutions. In tests involving 2 platforms, in which the subject had to go back and forth from one to the other, both subjects failed after bilateral extirpation.

Critical Summary of Experiments on Intelligent Behavior. The principal contribution to fact of these experimental studies of primate intelligence is the comparative data they provide of the relative abilities of the different primate types. While information as to individual and species differences in ability has a certain value, it, nevertheless, does not have behind it the social justification of the human intelligence test program. Problems of vocational guidance, mental hygiene, etc., in sub-human primates simply are not serious or pressing enough to demand a similar program of primate intelligence testing. Instead of being interested in 'performances' or 'capacities' from the normative point of view of what the individual or species can do, the problem of intelligent behavior in animals should be attacked, pri-

marily, from the viewpoint of analysis and understanding of the underlying mechanisms.

Very few of the investigations, however, have thrown any light on the mechanisms which lie behind the behavior of their subjects. It is true that attempts have been made to describe the behavior in detail, and some experimenters have offered interpretations in terms of such concepts as ideation and reasoning. For the most part, however, the latter have been extremely vague and unsatisfactory. Certainly none have ever provided a very intimate account of how ideas or rational processes operate to bring about the solution of problems. The same criticism applies to the Gestalt interpretations in terms of insight.

Experimentation in this field should, in the future, be directed at determining what the factors are which condition the success of one individual or genus, and the absence of which limits the achievements of another. Are such differences in problem-solving ability a function of certain differential sensory or motor abilities, are they due to differences in the kind and amount of the habit equipment of the subject, or are they the result of fundamental differences in the association-formation capacities of the animals? Our only hope of explaining these phenomena in the sense of being able to deduce (or predict) them from more basic principles lies in the direction of such an analytical approach. Whether stimulus-response concepts and association principles, or field concepts and Gestalt principles, will prove the better aid to such an experimental attack remains, at present, an open question. Up until now, neither has any major achievement to its credit which might suggest that it possesses a definite advantage.

Ideational (Symbolic) Behavior

The investigations reported in this section have had as a primary objective the experimental demonstration and description of ideational or symbolic processes in the behavior of their subjects. The problems employed have been assumed to exhibit such reactions and, where solutions are involved, to require their presence.

Multiple Choice. Hamilton (**36**) devised and used a multiple choice method for studying and analyzing the behavior tendencies of human and animal subjects.

His method involved the presentation to the subject of an insoluble problem-situation which permitted 4 alternative response possibilities, only 1 of which on any trial was correct. The procedure was such that the correct response

was varied from trial to trial and the same response was never correct in succeeding trials. This type of situation obviously operates against the formation of a specific habit and tends to favor a varying of modes of adaptation throughout the series of trials.

From an analysis of the behavior of his subjects, which included normal and sub-normal human adults and children, monkeys, dogs, cats, and 1 horse, Hamilton described and classified 5 different modes of adjustment. These, in turn, were related to 5 levels of reaction tendencies, the highest of which he termed "the rational inference tendency," because it involved the avoidance (beyond chance expectation) of the last correct, and hence inferentially incorrect, response. Hamilton found that there was a definite correlation between the distribution of these reactive tendencies and the position of the organism in the phylogenetic scale. Thus, human subjects exhibited the largest proportion of the higher reaction tendencies and the smallest proportion of the lower, simpler modes of adjustment. The monkeys were next to the human subjects, displaying a larger proportion of the "rational inference" type than any other animal. Only in human adult subjects, however, did this highest form of response predominate.

In a later study (37) in which 20 girls, 1 baboon, 4 monkeys, 1 mouse, 17 rats, and 6 gophers were tested, Hamilton found that individual differences in the variation of modes of response were more marked than those between different groups of animals. Nevertheless, the children showed the greatest tendency to react inferentially, while the infra-human primates came next.

Tellier (117) has reported that her monkey learned after 30 trials in a three-box situation not to respond to the one in which food had last been found. When the number of boxes was increased to 4, the subject made only 2 incorrect responses in 12 trials, and in a ten-box situation it made no errors for 10 successive trials after 31 trials. It is difficult to see what significance should be attached to the ability to make the proper avoidance response to a larger and larger number of boxes. From the purely statistical point of view the problem becomes a simple one, for the probability of repeating the same response becomes less the greater the number of boxes.

A somewhat different type of multiple choice method for studying complex modes of adaptation in animals is that developed by Yerkes (149). This method is similar to Hamilton's in that all specifically directive sensory cues are excluded and the subject must vary the place or locus of its response from trial to trial. It differs, however, in that it presents problems which may be solved by the subject on the basis of the perception of the constant spatial rela-

tionship of the correct response mechanism with respect to other available mechanisms. This method, then, not only provides data on the various types of reaction tendencies exhibited by the subject, but also throws light on the mode of discovery and nature of the correct solution.

Several studies of the behavior of primates have been carried out by this multiple choice method. Yerkes (**149**) tested 2 monkeys *(Pithicus irus* and *Pithicus rhesus)* and an orang in the following relational problems: (1) the first box at the left, (2) the second at the right, (3) alternately first at left and first at right, and (4) the middle one. The rhesus monkey made the best record, solving the first 3 problems and failing in the fourth. The irus monkey succeeded in problems 1 and 2, failed in problem 3, and was not presented with problem 4. The orang, Julius, solved only problem 1 and required more than twice as many trials as did the monkeys. He failed to learn problem 2 in 1,380 trials. Partly on the basis of the suddenness with which the orang solved problem 1, and partly because it responded with high accuracy to a control series involving new settings, Yerkes concluded that the orang's solution was a more intelligent one than those of the monkeys. He suggested that the poorer performance scores of the orang were due to ineffectual use of ideas.

The gorilla, Congo, failed to learn the problem of middle box in a manual multiple choice apparatus even though electric shock was administered for incorrect responses. A maximum of 5 boxes was employed and most of the settings involved only 3. When shown the food in the correct box before the response (delayed response), Congo made 8 out of 10 correct responses. Work was discontinued when the behavior of the animal indicated discouragement and aversion to the task (Yerkes, **151**).

An extensive investigation of the behavioral adaptation of chimpanzees to multiple choice problems was carried out by Yerkes at the Florida station of the Yale Laboratories of Primate Biology (**156**).

Four adolescent subjects were presented with 6 different relational problems: (1) left-end box; (2) second from right-end box; (3) right-end box; (4) middle box; (5) alternately the left-end and the right-end boxes; and (6) the same box, no. 5, whatever mechanisms were presented. Of the 24 problem presentations there were 14 (58%) successful solutions. Six of these were described by the experimenter as being abrupt while 8 were achieved gradually. None of the subjects succeeded with problem 4, the middle box, and only one was able to master problem 2, the second box from the right end, and problem 5, in which the correct box was alternately at the left and

right end of the group. All of the subjects displayed a wide variety of response tendencies or systematizations in their attempts to discover the solution.

The occurrence of sudden adaptations to these relational problems plus the ability of his chimpanzee subjects to respond correctly to new (control) series of settings, were interpreted by Yerkes as evidence of solution by "discovery," or "insight" into the significant relations, as contrasted with solution by a blind process of trial and error elimination. The chimpanzees exhibited a marked superiority over other mammals, for which comparable data are available, in the ability to respond to control series involving new settings.

Providing still further evidence of its remarkable capacities, Tellier's macaque monkey, Coco, succeeded in solving the problem, second box from the left end, in 159 trials (**117**). While the conditions of the experiment (type of apparatus, previous experience of subject) were not comparable with those of Yerkes, this record compares with 410 and 1,080 trials required by 2 monkeys to learn this problem and the failures of an orang and 3 chimpanzees. Furthermore, Coco displayed an ability equal to that of the chimpanzee to respond to a new series which involved not only different settings, but variations in the spacing of the boxes.

Buytendijk (**15**), Révész (**97, 98**) and Kuroda (**79**) have also trained monkeys on multiple choice problems of the Yerkes' type but with little success. One problem in particular that has proved to be very difficult, if not impossible, for the monkey to solve is that in which the correct box is alternately at the right and left end. This problem is essentially the same in principle as the delayed alternation problem, which, as Jacobsen and Nissen (**50**) have demonstrated, is relatively more difficult in a visually dominant animal, such as the monkey, than the delayed response problem. The consistent failure of subjects to solve this problem in multiple choice experiments is probably to be accounted for, then, by the fact that the intervals between trials were too long.

Double Alternation. Two studies of the behavior of monkeys in the double alternation problem have been reported by Gellermann. In the first experiment (**25**), 2 monkeys learned the response RRLL in a temporal maze. Their performance was definitely superior to that of the white rat and raccoon in a similar type of apparatus. In a second experiment (**26**) 4 subjects were trained in the double alternation of a series of 8 responses RRLLRRLL with a new alternation box-apparatus. After learning this problem to the criterion of 10 correct trials in succession, all 4 subjects were able to perform perfectly in extended series of 12 to 16 responses. The ability to master and extend the double alternation problem has been assumed to

indicate the presence of some symbolic or central neural process which controls the response.

In summary of this section, the investigations reported have been largely of an exploratory nature. They have revealed the primates to be capable of numerous and varied modes of complex adjustment, but have not greatly increased our understanding of the behavior. Neither have the experimental demonstrations of the presence of ideational processes been too convincing. Certainly sudden drops in the error curves of learning any problem are not proof of the existence of such factors. And, similarly, the successful performance of the double alternation problem by monkeys and human subjects, as contrasted with the failure of the white rat and raccoon, does not greatly increase one's confidence in the hypothesis that the monkey's solution was based on symbolic processes. These experimental methods have progressed little, if any, beyond the stage of development of the intelligence or so-called insight tests. They have revealed differences in performance ability, but have not advanced our knowledge of the factors underlying these differences.

Number or Counting Experiments

A few investigators have attempted to study the ability of monkeys to count or to appreciate differences in the number of objects. Kinnaman (**58**) presented 2 rhesus monkeys with the problem of responding to the fourth container of 21 similar containers placed in a row, and then to the second, fifth, first, ninth, eleventh, eighth, third, tenth and seventh in the order given. His results led him to conclude that one of his subjects recognized, in this situation, numbers from 1 to 6 and the other from 1 to 3.

Woodrow (**147**) trained 3 rhesus monkeys to reach for food in whichever of 2 stimulus series contained the larger number of sounds, and to refrain from reaching in the series containing the smaller number of sounds. Successful differentiations between series of 1 and 3, 2 and 3, and 3 and 4 sounds were obtained by 2 subjects. Evidence that the discrimination did not involve an appreciation of the abstract property of number was indicated by the fact that 1 of the subjects had to relearn to discriminate between 2 and 3 sounds when the intervals between the first and last sounds of the series were equated.

Kuroda (**80**) taught a monkey to learn to respond to the left-end hole in a box at the sound of 1 stroke of a bell and to the second hole from the left at the sound of 2 strokes. When the subject had to

choose between 1 of 3 holes, the third one indicated by the sounding of 3 strokes of the bell, the habit completely broke down. This result was interpreted as indicating that the subject was able to discriminate on the relative basis of "moreness," but not to absolute magnitude (whether number or not) which the three-response situation demanded.

Kuroda (80) also reported a number of tests with 2 monkeys in which, after food had been obtained a certain number of times, a shock was administered when the subject next put his hand into the food window. The monkeys were unable to learn to anticipate the shock trial even when only 2 food trials in succession were given. When only a single food trial was given and then a shock trial, they were successful. In the latter form, the problem becomes one of simple alternation of response.

Bierens de Haan (9) was more successful in training a young Java monkey in this type of problem. His subject learned to respond twice in succession and then to refrain from responding on the third presentation when no reward was given. However, various tests, such as giving 2 pieces of food on the first time and seeing if the animal would refrain from responding on the next presentation, led to the conclusion that the monkey did not have a conception of numbers but merely gave a rhythmic response based on the training sequence (++—). Gallis (24), on the other hand, succeeded, after a long period of training to the number 3, in getting his 2 *Macacus sinicus* monkeys to refrain from attempting to open the hand next presented if 3 worms were given on the first trial, and to restrict themselves to only 1 further attempt if 2 worms were presented. Gallis' results led him to conclude that his subjects understood the concept of the numbers 2 and 3.

Mnemonic Capacities: Delayed Response

Introduced as a method for studying ideational processes in animals, the delayed reaction experiment typically requires the subject to retain over a period of delay the appropriate cues as to which of 2 or more alternative responses to make. The test has come to be regarded as a method of studying the mnemonic capacities of animals, and experiments have been directed at such problems as determining the length of time that different kinds of animals can successfully delay, various factors that influence the length of delay, and the nature of the representative factor or mechanism by which the animal is able to bridge the interval.

Generic Differences in Ability to Delay. Because of the extent

to which delay limits are a function of variations in experimental conditions, comparisons of individual and generic abilities can be made only when the test conditions are strictly comparable. This requirement usually precludes comparisons from one investigation to another. However, several investigators have undertaken direct comparisons between different primate genera and between infra-human primates and human infants and idiots.

Harlow and his collaborators (**38**, **39**, **87**) tentatively ranked the primates in the following order of ability as indicated by the maximal delays obtained and by the speed of original adjustment to simple and complex delayed reaction tests: anthropoid apes, baboons, old world monkeys, South American monkeys, and lastly the lemur. Comparisons of human idiots and low grade imbeciles with the sub-human primates indicated that while the former showed a more rapid initial adaptation to the problem, they attained about the same final level of performance. The capacity of the brighter monkeys, particularly the baboons, appeared to be on about a level with that of a human subject with a mental age between 2 and 3 years.

Tinklepaugh (**124**) employed multiple or serial delayed response problems which involved varying numbers of pairs of boxes. The subject saw lures placed under a series of pairs of containers and then was required to make its choices from the pairs, either in the order in which the lures were placed or in broken or reverse order. Two chimpanzees were markedly superior to 2 macaque monkeys. Whereas the latter failed in a test with 8 pairs of containers, the chimpanzees were capable of responding with an accuracy of almost 80% in the sixteen-pair situation. In a single test with the sixteen-pair problem, 4 of the 5 adults and 2 of the 4 children were able to respond better than chance.

Kellogg and Kellogg (**56**) compared a human infant of 10 to 12 months of age with a chimpanzee 2½ months younger in their ability to make delays. The child failed at 10 minutes, whereas the chimpanzee showed partial success in the thirty-minute delay tests. A comparison of gorilla and chimpanzee is provided by the experiments of Yerkes (**152**, **153**, **160**), who used a form of delayed response situation which involved a choice among 4 food boxes, placed at the 4 points of the compass with respect to the subject. When the response was to the position or location of the box the gorilla was successful after 3 hours delay, while 2 of the 4 chimpanzees successfully delayed 3 hours and 2 showed some evidence of being able to delay 4 hours. The results are based on a very small number of

trials and thus do not provide a very reliable basis for conclusions.

Factors Affecting Delayed Response. (1) *Distance Between Food Containers.* The length of delay intervals obtained for primates in the various experiments ranges from as low as 30 seconds to 15 or 20 hours. The latter result, obtained by Tinklepaugh with monkeys (123), is not characteristic of the findings of other investigators. In fact, most experimenters report delay limits for monkeys which range between 1 and 3 minutes. The difference is to be accounted for, partly, in terms of the distance between food containers. In Tinklepaugh's situation this distance was 6 feet as compared with 10 to 20 inches employed by other investigators.

The chimpanzee, likewise, exhibits a much briefer delay limit when the food boxes are close together (**51**, **91**, **92**).

Jacobsen, Wolfe, and Jackson (**51**) found that when the distance between the 2 test objects was reduced from 30 to 10 inches, the delay limit dropped from about 3 to 5 minutes down to 1 minute. In a delayed reaction apparatus which was arranged to permit independent variation of the distance (1) between the 2 food containers and (2) between the ends of the 2 cords by means of which the containers are drawn in, Nissen, Carpenter and Cowles (**91**) found that increase of the first resulted in a more accurate performance, whereas increase in the second had little effect on performance scores. This result successfully isolated the factor of stimulus differentiation, and not the spatial distinctiveness of the critical response, as being the important one.

When more than 2 containers (3 to 7) were used, Buytendijk (**15**) reported that a monkey did very poorly even when the delays amounted to only a few seconds. Similarly, Yerkes (**151**) found that the young gorilla, Congo, failed with delays of 1 minute in a five-box situation. However, neither of the animals was given extensive training in the situation. No difference was found by Yudin and Harlow (**161**) in the difficulty of the delayed reaction problem when the 2 containers were placed in a vertical rather than the usual horizontal plane.

(2) *Practice.* Foley and Warden (**22**) concluded from their study with monkeys that practice undoubtedly improved delayed response performance. They employed the indirect method and gave their tests after a long period of preliminary adaptation and training, in which the association between the stimulus light and the lure was firmly established. Nissen and Elder (**92**), on the other hand, found that, following preliminary adaptation to the situation in which a more or less gradual improvement in accuracy of performance was manifested by their chimpanzee subjects, practice, of itself, did not appreciably affect either the score on a given delay interval or the limits of delay. The discrepancy between these results is probably to be explained, as Nissen and Elder point out, by the fact that the

monkeys were still in what they called the preliminary stage of adaptation. Prior to the tests they had no actual experience with the delay situation.

Several investigators (**14**, **48**, **49**) concerned with the effect of the removal of various cortical areas have found that their subjects have shown a slight improvement in delay scores in post-operative tests as compared with those in pre-operative tests. This improvement has been interpreted as being due to the better emotional adaptation of the subjects, which is often quite marked following operation, rather than to any improvement in the function tested.

(3) *Incentive.* The effect of quantitative variations of the food incentive on delayed response performance with 4 chimpanzees was studied by Nissen and Elder (**92**). Their data showed that an increase in the amount of incentive resulted in longer delay limits and that a decrease led to shorter limits. Not only did the amount of incentive affect the response within a given trial, but it also had a general perseverative effect on subsequent responses, increasing or decreasing the level of performance according to the relative size of the incentive.

Maslow and Groshong (**86**) compared the influence on the efficiency of delayed reaction performances of 3 different foods whose relative motivation values differed as determined by previous preference tests. The results indicated that when there was a relatively large difference in preference for the foods, there was a significant difference in efficiency of performance in the delayed reaction tests. Unlike the results of Nissen and Elder, whose data showed that the relative increase in delay limit was greater than the corresponding relative amount of incentive used, Maslow and Groshong found that a large difference in the incentive value of the food was required to produce a relatively small difference in efficiency of performance.

(4) *Age and Sex.* In their investigations with zoo animals Harlow and his co-workers (**38**, **86**) obtained some evidence which suggested that very young subjects were inferior to mature adults in delayed reaction. The poorer performance of the younger animals is probably related to such factors as their greater timidity and lesser degree of motivation. Too little data is at hand, however, to draw any definite conclusions as to variation of the ability to delay response with age.

A similar situation exists for sex differences. The only observation reported is one by Yerkes and Yerkes (**160**) which indicated that their 2 female chimpanzees were markedly superior to 2 males

in delayed response. Again this difference might be a function of such a characteristic as the greater activity of the males and not of any poorer mnemonic ability.

Relation of Cortical Areas to Delayed Response. As the result of a number of neurological investigations it has been discovered that the ability of primates to perform delayed response (also delayed alternation) is intimately related to the frontal association areas.

Jacobsen (**46**, **47**) and Jacobsen and Nissen (**50**) reported results with monkeys which show that this ability was entirely abolished by complete bilateral lesions of the frontal areas, while subtotal bilateral lesions produced a shortening of the delay time. Unilateral lesions, on the other hand, caused no impairment of performance. Similar results have been presented for the chimpanzee (**51**). These investigations showed, moreover, that only tests which depended upon recent memory (delayed response) were affected by frontal lobectomies. Memory for problem-box solutions and for various types of visual discrimination habits was not impaired, nor was the ability to learn new problems of a similar nature.

None of the other cortical areas studied, the post central convolutions by Breslaw, Barrera, and Warden (**14**), the temporal lobes by Jacobsen and Elder (**48**), or the motor and premotor areas by Jacobsen and Haslerud (**49**) has been shown to have any relation to this capacity. At least their ablation has in no instance adversely affected delayed response performances.

Delay to Non-spatial Cues. In the majority of investigations of delayed response the essential cue has been a spatial one. The subject must remember the particular locus of the loaded food container as contrasted with alternative empty containers which occupy different positions in space. In contrast to this spatial form of problem is the type of test in which the subject must make use of non-spatial cues, such as color, form, or size of the food container.

Tinklepaugh (**123**), who employed dissimilar containers in the early trials with his monkeys, seemed to think they made use of this difference because they became very hesitant and uncertain in their choices when the containers were made alike. He did not demonstrate, however, delayed response to non-spatial factors. Kohts (**75**, **77**) introduced a delay in her sample-matching method and found that it is apparently far more difficult to carry over non-spatial cues, for her chimpanzee, Ioni, failed if a delay of more than 15 seconds was inserted between the showing of the sample and the choice of the similar object.

Employing a turn-table form of apparatus which readily permitted the elimination of spatial cues, Yerkes (**153**) presented evidence to show that the gorilla could successfully delay response as long as 10 minutes to the visual appearance (color) of the food container. That the task was an exceedingly difficult one for the subject is shown by the fact that it responded

with only 64% accuracy in the 14 trials at 10 minutes as compared with a chance expectancy of 33%.[3]

Yerkes and Yerkes reported an experiment on the ability of a chimpanzee to make delayed responses to color (**55, 160**). Basing their conclusions more on the manner in which their subject made its responses rather than the percentage of correct choices (which were only slightly above chance expectancy) they concluded that, although obviously difficult for the chimpanzee, delayed response to color appeared after at least 30 minutes.

The only definite conclusion that can be drawn from the fragmentary evidence thus far at hand is that delayed response to such visual characteristics as color, form, and size is a very difficult achievement even for the anthropoid apes. Little or nothing is known about the limits of delay, except that they probably will prove to be shorter than those for spatial cues, even when the visual differences are maximal.

Mechanisms Bridging Delay Interval. Only very meager information has been provided by these experimental studies as to the nature of the behavior mechanisms by means of which the organism bridges the delay. In the case of delayed response to position, the various investigations have invariably reported that primates do not maintain any overt orientation of either all or a part of the body during the delay interval. In the absence of such a cue, it has been assumed that the response is mediated by some intra-organic function, or representative process, which is either retained throughout the interval or rearoused by the situation at the time of response. In tests in which disorientation and distractions were introduced into the delay period by feeding the subject at the opposite end of the experimental cage, Harlow (**39**) showed very conclusively that his monkeys were not dependent on bodily orientation. The simplest explanation of their behavior, according to Harlow, seemed to be that it was under the direction of what Hunter has termed "kinesthetic sensory ideas." However, further tests with double delays, and tests involving alteration of the absolute and relative positions of the containers, indicated that differential kinesthetic cues were hardly adequate to account for the behavior.

Nissen, Carpenter, and Cowles (**91**) attempted to determine

[3] While 6 boxes, 3 large and 3 small, were employed, the small boxes were seldom baited (4 times only in 70 trials), with the result that it was necessary only to remember in which of the 3 large boxes the food was placed. Naturally, the animal would come to respond exclusively to the large containers in such a situation, as is shown by the fact that all except the first of the 4 trials in which the small can was baited were incorrect.

whether the representative factor in the spatial problem involved predominantly stimulus differentiation or response differentiation. Their data indicated that increased separation of the food containers (stimulus differentiation) favored accuracy of response, whereas increased differentiation of the critical response had little or no influence. This result led them to suggest that "the critical association was one between the visual appearance of the baited food container and an approaching response or tendency" (**91**).

Employing his "substitution method," in which a shifting of either the kind or the amount of the lure is made without the subject's knowledge, Tinklepaugh (**123**) interpreted the behavior of his monkeys as showing evidence of representative factors which stand not only for objects, but also for certain qualitative and quantitative aspects of these objects. The experiments (**86**, **92**) on the influence of the amount and preferential value of the incentive on delayed response performances likewise indicate that these characteristics of the stimulus are a part of, or in some manner affect, the representative factor.

Several studies (**38**, **92**, **124**, **160**) have shown that this "representative process" must compete for control of the critical response with various other response tendencies, such as the tendency to respond to the nearest food container, position preferences, and the tendency to repeat the previous correct response. Finally, the neuropsychological investigations have indicated that, whatever the nature of this hypothetical factor, it is peculiarly related to the functioning of the frontal association area of the cortex.

Other Tests of Mnemonic Capacity. Nellmann and Trendelenburg (**90**) employed a problem box to study the ability of their baboon and rhesus monkey to remember the direction in which the lid opened. With tests in which the box was presented in any 1 of 4 positions they found that the animals were successful until the delays were beyond one-half minute.

The ability of animals to recall the location of buried food without the help of immediate sensory cues has also been employed as a measure of memory in animals. Köhler's chimpanzees immediately located buried food after an interval of 16½ hours (**74**). Yerkes found that the gorilla, Congo, was successful after delays of 48 hours (**151, 152**), while positive results were also obtained for this same length of time with 4 chimpanzees (**160**). The latter failed in 72- and 96-hour tests. This type of experiment presents major difficulties, both of experimental control and of scoring. Thus Yerkes recorded responses as being successful when the subject began to dig vigorously at the proper location even though it did not obtain the food.

In concluding, mention should be made of the fact that, although retention tests have occasionally been given to primates, no systematic investigation of the retention of various types of learned habits has been made. Yerkes (**152**, **153**) has reported that adaptations acquired by the gorilla, Congo, to such mechanisms as hooks, snaps, and padlocks persisted over a period of 11 months. Other investigators (**58**, **74**, **76**, **104**, **124**, **152**) have also obtained incidental data which have indicated that problem solutions and habits are retained by primates over long periods of time. On the other hand, Yerkes (**156**) has reported that solutions of multiple choice problems were not retained by chimpanzees, even in instances when no other problem was learned in the intervening time. More surprising was the finding that a problem, the solution of which has been lost either by reason of learning a conflicting problem or failure of retention, was not solved more readily on re-presentation than originally.

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BOOK REVIEWS

ANASTASI, ANNE, *Differential Psychology*. New York: The Macmillan Company, 1937. Pp. xviii+615.

The author has written an excellent, well integrated survey of the literature on the topics usually dealt with by books on individual differences. The book is intended for the undergraduate who has neither had training in statistics nor acquired any special knowledge of mental tests.

The general outline for treatises of this sort was set by Thorndike in his treatment of the subject in the third volume of his noted work on *Educational Psychology*, published in 1914. To a considerable extent the more recent volumes of R. S. Ellis, F. S. Freeman, and Anastasi make their contribution by bringing Thorndike's outline of the subject up to date. Two general viewpoints run through all these works. The first of these is that all individual differences are quantitative. Thus, as Anastasi puts it, " every individual can be described in terms of the same traits," so that differences between individuals may be regarded as differences in the amounts they possess of a fixed set of traits, a trait being any unidimensional characteristic. The second fundamental viewpoint is that the science of individual differences must of necessity deal with behavioral phenomena. As a matter of fact, these " behavioral phenomena " consist largely of the scores made on mental tests. In large part, then, the science of differential psychology consists in the study of test scores—more in particular, in the variation in these scores that can be attributed to variation in the individual or groups of individuals who make them.

The author divides her book into two parts, the first entitled " Fundamental Principles of Individual Variation " and the second, "Analysis of Major Group Differences." The topics dealt with in Part I are the following: the distribution of test scores; the relative influence upon individual differences of heredity and environment; the relation between mental and physical traits; types; inequalities in the amounts of an individual's various traits; and the interrelationship of abilities, the last mentioned subject being treated under the chapter-heading " Mental Organization." There is also an historical introduction.

The second portion of the book consists mainly of a comparison of groups: abnormal groups such as those characterized by feeblemindedness or genius; the sexes; the races; and urban and rural populations. This portion of the book, like Part I, emphasizes the necessity of a cultural or environmental interpretation. There is also a concluding chapter, in which individuality is discussed as a resultant of the various groups of which the individual is a member. Although each individual undergoes experiences which are unique to himself, " such experiences are less significant . . . in shaping the more basic aspects of his personality than is his shared behavior." Both parts of this book are notable for the inclusion of descriptions of the findings of a large number of investigations, particularly of the more recent ones. On the whole, the selection made from the bewildering number of publications in this rapidly developing field is fair and representative.

One might expect that the discussion of the topic of Chapter II, the " Nature and Extent of Individual Differences," would constitute a major portion of a treatise on individual differences, instead of forming but one of twenty chapters. It seems to be a fact, however, that in the case of many traits, it is difficult to find reliable score distributions on large properly selected groups and that the scores themselves, even when available, carry little meaning except to an experienced student of mental tests. It would be interesting, for example, to know the distribution of visual acuity among, say, ten thousand school children of each age; or of keenness of pitch discrimination; or even of Binet mental age. Although the fundamental description of individual differences in any trait consists in a frequency table of the scores, Anastasi gives but one such table, listing scores on an undescribed " simple test of learning." She does, however, give a dozen or more illustrative description curves. The main purpose of the chapter is to inculcate the idea that as a rule score distributions are approximately normal, and to give some account of conditions which more or less spuriously lead to bimodal or skewed distributions. The author also points out that with available psychological tests it is impossible to compare variability from one trait to another—a statement which should give pause to those writers who have stated that variability is greater in the " simpler " than in the more " complex " or, phylogenetically conceived, more recently acquired, traits.

The treatment of the effect of training (including practice) on individual differences is somewhat more technical than the other

chapters. Very properly the writer inclines to favor the use of scores in units of amount done in unit time rather than those in terms of time per unit work, and recommends the standard deviation rather than the coefficient of relative variability as a measure of individual differences.

The chapter on types is also worthy of special comment because it brings together in a well organized discussion the various type theories which in recent years have attracted so much attention. After a careful analysis of three lines of evidence concerning the matter, the author's well substantiated conclusion is that "all the better controlled studies . . . yielded overwhelmingly negative evidence."

The most striking characteristic of the entire book, however, is the constant emphasis upon environment as the chief cause of individual differences. Taking up the subject of heredity *vs.* environment in the third chapter, the author never lets the reader forget it in any of the remaining seventeen chapters. It would probably not be an exaggeration to refer to the book as an interpretation of individual differences from the cultural viewpoint. The author uses her very keen statistical and critical ability to point out flaws on the part of those numerous investigators who, in study after study, have concluded that heredity plays an important part in determining individual differences. In most cases she not only points out that the influence of heredity has not been proved, but manages to give a plausible explanation of the facts in terms of the influence of environment. It is possible, however, that advocates of the importance of heredity in the determination of abilities will feel that Anastasi does not criticize environmental explanations with the same acumen that she directs against the opposed hypotheses.

In accordance with this emphasis upon environment, little stock is taken in the concept of maturation as one to account for the changes with age in child behavior. The sequence of development is not fixed by innate constitution. Likewise, "a mental growth curve is at best a practice curve obtained in the absence of controlled conditions." Similarly, the writer states, "The more the individual has learned in the past, the more he will be able to learn in the present. To use a rather crude analogy, we might say that practice does not add to the individual's ability, but multiplies it." It would be interesting to have a further elucidation of this view in order to bring out its connection, if any, with the fact that practice curves are often, perhaps usually, negatively accelerated.

Among the more special doctrines entertained is one that no dis-

tinction can be legitimately made between the *extent* of a person's abilities and the *level* or difficulty of task which he is capable of mastering. The difficulty of a task, the writer believes, " will unquestionably prove to be a function of the number of different specific abilities involved." From this statement it would follow that correctly to discriminate a small difference in pitch " involves " a larger number of abilities than correctly to discriminate a large difference, since the former task is the more difficult. The reviewer feels that the truth of this doctrine, stated by Anastasi in the form of a broad generalization, not only is not, but could not be, substantiated.

Dr. H. L. Hollingworth has contributed a brief and well-worded introduction, in which, curiously enough, he uses a phrase that seems to contrast rather sharply with the most emphatic theme of the book when he indirectly refers to the author as one " who is equipped with technical tools and *native endowment* to know and to expose sources of error " (reviewer's italics). All will agree with Dr. Hollingworth, however, concerning the general soundness, authenticity, range, and clearness of presentation that characterizes her present important contribution to the literature on differential psychology.

HERBERT WOODROW.

University of Illinois.

GARTH, THOMAS R., *Educational Psychology.* New York: Prentice-Hall, Inc., 1937. Pp. xvi+319.

In view of the plethora of textbooks in general and educational psychology one may legitimately insist that a new addition in either field present a new organization of the field, a summary and systematization of current experimental data and special theories in the field, or a more effective presentation of the material to the student. Garth's *Educational Psychology* serves none of these functions unequivocally.

Garth's textbook offers no new perspective on the field of general or educational psychology. Intended as behavioristic, but with a liberal use of mentalistic concepts, the systematic point of view is a mixture of Watsonian behaviorism and the psychology of Thorndike as represented in his *Educational Psychology* of 1913. The theoretical difficulties that follow from such a combination have been ignored, rather than resolved, as have the generic difficulties of an elementaristic point of view. Nowhere in the treatment of the fundamental concepts of psychology are the constructive notions of organismic or Gestalt psychology adequately reflected. The reflex remains the

genetic unit of behavior and all the forms of behavior called learned result from stimulus substitution. Moreover, these modifications of behavior are "explained" by reference to specific synaptic resistance changes.

Although the author states that it is his desire "to convince the reader and the student of the scientific character of psychology" (viii), the most serious criticism of the text is that the thought and research of psychologists during the past ten years have been considered only sporadically in arriving at empirical generalizations. A crude indicator of the justice of this criticism is the fact that only 9 of Garth's 47 references to the literature on learning and thought are dated later than 1927, and only 1 of these 9 is dated later than 1932. The specific generalizations regarding learning and memory reflect this laboratory-textbook time lag. For example, the author takes as his credo the statement that the principle of conditioning ('associative shift,' 'substitute stimulus') "accounts, in theory, for all modifications or changes in behavior that are made in learning" (p. 112), but the serious attempts of Hull [1] to develop a thoroughgoing CR theory of trial and error learning, insight, and memory phenomena are neglected, as is perhaps most clearly revealed by the fact that Garth attributes the trial responses of the organism during problem solution to "random activity." The remainder of the treatment of learning is given over to the Thorndikean laws (Exercise, Effect, and Readiness) and to the description of trial and error learning and insightful learning as revealed in the classical studies of Thorndike, Köhler, Bryan and Harter, and others. Although Thorndike's *Fundamentals of Learning* (1932) is included in the list of references for the student, the older statements of the laws of learning are consistently adhered to. Thus, the fixation and elimination of responses is said to be determined by their satisfyingness or annoyingness, and the determinant of satisfyingness and annoyingness is "the readiness of the conduction units to conduct" (p. 116). Belongingness, the spread of effect, the confirming reaction, the failure of punishment to have a direct effect on the strength of a connection—all are ignored. Perhaps the most noteworthy of the omissions in the treatment of learning, in view of the purpose of the text, is the failure to mention any of the studies of guidance in learning carried on by Carr and his associates.[2]

[1] C. L. Hull, Conflicting Psychologies of Learning—A Way Out. *Psychol. Rev.*, 1935, **42**, 491–516.

[2] Harvey Carr, Teaching and Learning. *J. Genet. Psychol.*, 1930, **37**, 189–219.

The treatment of memory is consistent with the treatment of learning. The author states only a few of the generalizations that are permitted by the extensive literature on the form of the curve of learning, the distribution of practice, the character of the material learned, and the whole-part problem. In addition, forgetting is said to be " merely the reversal of retention, and normally is the result of disuse. Time, with no renewal of practice, or repetition, tends to erase the fixation" (p. 144). The Law of Disuse is thus perpetuated as the sole explanatory law of forgetting in spite of the overwhelming evidence for the primary importance of retroactive inhibition.[3] The treatment of the problem of transfer of learning likewise reflects a neglect of the problem of negative transfer (interference) and there is a consequent weakness in the theoretical discussion of that topic.

The time-lag in the treatment of other fields of psychology may be fairly represented by the following. In a chapter devoted largely to the structure of the nervous system, the reader is informed that " the structural unit of the nervous system is the reflex arc " (p. 60), " the function of the spinal cord is to house the mechanism of non-variable action " (p. 62), and " in the frontal lobe is found the seat of voluntary action, such as speech, writing, and all learned activities " (p. 68). The work of Lashley is not presented, but it is stated that recent studies of the functional activity of the nervous system do not qualify in any significant way the statements cited. In the chapter entitled " The Problem of Original Nature " (II) neither the work of Coghill[4] nor the concept of individuation of response receives mention, as might be expected from our previous statement that the reflex is taken as the genetic unit of behavior. Finally, there is no treatment in this text of the fundamental theories and facts regarding the organization of mind which have loomed so large in general and educational psychology during the past two decades, nor, of course, of the recent developments in factor analysis. In fact, even the most elementary statistical concepts are not treated.

These criticisms assume that a textbook of educational psychology should reflect the fundamentals of psychology as they emerge from contemporary research. This assumption is especially defensible in the present instance since Garth's textbook is almost indistinguishable from current textbooks of general psychology as regards the topics

[3] J. A. McGeoch, Forgetting and the Law of Disuse. *Psychol. Rev.*, 1932, **39**, 352–370.

[4] G. E. Coghill, *Anatomy and the Problem of Behavior.* Cambridge, England: University Press, 1929.

considered. It is clearly intended for courses in educational psychology that replace rather than supplement an introductory course in psychology. It has all the chapters common to introductory textbooks of psychology, and the educational intent of the author is revealed clearly only in four chapters entitled "What is Educational Psychology" (I), "Directing the Learning Process" (XII), "How to Study" (XIII), and "The Measurement of Achievement and Capacity" (XV).

A list of references is given at the end of each chapter, and these are supplemented by occasional footnote references. The references are, however, not well-planned as an aid to the inquiring student. One-third of all the references are to other textbooks in general or educational psychology, and specific page references are rarely given. On the other hand, some studies are mentioned in the body of the text without offering the student complete citations either in the footnotes or terminal references. Finally, 40 of the 177 references given at the ends of the chapters have some error or omission in the citation.

Even one aware of the dangers of perfectionism cannot condone in a textbook such flagrant editorial laxity, nor such freezing of psychological theory and fact in the mold of a decade ago.

Arthur W. Melton.

University of Missouri.

Whitwell, J. R., *Historical Notes on Psychiatry: Early Times—End of the 16th Century.* Philadelphia: P. Blakiston's Son and Company, Inc., 1937. Pp. xii+252.

Dr. Whitwell was Medical Superintendent of St. Audry's Hospital in Suffolk, and is now Honorary Librarian of the Royal Medico-Psychological Association. His book somewhat overlaps the contributions by Farrar, by Jelliffe, and others,[1] but also supplements them and is more accurate than Farrar and Jelliffe. Whitwell also includes

[1] Clarence B. Farrar, Some Origins in Psychiatry, *Amer. J. Insan.*, 1908, **64**, 530–552; 1908, **65**, 83–101; 1909, **66**, 277–294. Smith Ely Jelliffe, Notes on the History of Psychiatry, *Alienist & Neurol.*, 1910, **31**, 80–89; 1911, **32**, 141 ff., 297 ff., 478 ff., 649 ff.; 1912, **33**, 69 ff., 307 ff.; 1913, **34**, 26 ff., 235 ff.; 1915, **36**, 365 ff.; 1916, **37**, 35 ff., 158 ff., 287 ff., 331 ff.; **38**, 41 ff., 147 ff. G. M. Stratton, Brain Localization by Albertus Magnus and Some Earlier Writers, *Amer. J. Psychol.*, 1931, **43**, 128–131. John Malcolm MacEachran, A Philosopher Looks at Mental Hygiene, *Ment. Hyg.*, 1932, **16**, 101–119. H. A. Savitz, Maimonides' Hygiene of the Soul, *Ann. Med. Hist.*, 1932, **4**, 80–86. F. M. Harrison, Psychiatry in Historical Retrospect, *Ann. Med. Hist.*, 1932, **4**, 565–574; 1933, **5**, 85–95.

in footnotes many helpful translations and definitions of unfamiliar terms, and provides further references.

Whitwell presents here much material, quaint, superstitious, modesty-inducing, and hopeful, which like Farrar and Jelliffe he has not organized perfectly. He sketches earlier and later magical beliefs and practices, enabling the student "to move through a few degrees of longitude or latitude in order to find . . . the same views concerning mental disorder as those current in this country only a few centuries ago" (pp. 1–3, 104, 109, 120); ideas of the Chinese, Indians, Babylonians, and Egyptians; cases from the Bible, the Talmud, the Koran, and the classics illustrating psychoses, psychoneuroses, "the Scythian disease" making effeminate men, and crowd-madness; the classical medical writers, from Hippocrates to Felix Plater; the Middle Ages, with their lapse from Hippocratic to popular and theological views, but with courageous exceptions (Agrippa, Wierus, Vesalius, Reginald Scot, Henry Howard, St. Vincent de Paul); the ideas of the period covered on epilepsy, incubus, and acedia; references to Shakespeare, similarly (49n); and then, interesting "Translations and Extracts" covering the same period, many of them repeating what he had already cited, with occasional repetitions, in the first part of the book.

Whitwell's theoretical limitations complicate the organization in a few places. On the one hand he remarks that "nothing in modern psychiatry can well explain the vocalisation of the possessing devils who besought Jesus, 'If thou cast us out, suffer us to go away into the herd of swine'" (p. 27), a statement which the student of multiple personality might question. On the other hand, comprehending all nightmares under incubus, Whitwell remarks as casually that the "true explanation" of incubus is a "psychopathic condition based upon sex repression," citing Ernest Jones (p. 128), and among his Biblical cases inserts a three-page analysis of Pharaoh's dream "as displayed by modern psychoanalysis" according to M. K. Bradby (pp. 17–20).

Whitwell gives a good table of contents (pp. ix–xii), a list of men's dates (pp. 153–155; not mentioned in the contents), and "Some Chronological Data" on important psychiatric ideas (pp. 247–252); but no index.

For the historical student in psychiatry and psychology the book contains gems, as the following references show. What we call senile decay was recognized in Egypt c. 3000 B.C.; apparently tertiary syphilis in China c. 2600 B.C.; manic-depressive psychosis by

Aretaeus c. 90 A.D. and by others later; and waxy flexibility by Plater, 1536–1614, who also held intelligence hereditary and helpfully reclassified mental disorders (pp. 14, 7, 78, 175, 195–197, 102, 229 ff., 98). Hippocrates, c. 375 B.C., thought epilepsy hereditary; the Talmud discouraged marrying into epileptic families (pp. 62, 28).

Theories of mental health in China c. 2600 B.C. emphasized marrow; in India c. 600 B.C., food, poison, wind, phlegm, bile, and emotion (pp. 7–8). Indian practitioners of c. 1400 B.C. recognized divisions of the nervous system (p. 11). Pythagoras, c. 510 B.C., and later Hippocrates, considered the brain the central organ of mental life and disorder (p. 51). Hippocrates thought the brain was a gland; and even Vesalius and Plater saw no order in the convolutions (pp. 62–63, 102, 151). Erasistratus, c. 260 B.C., had said the many convolutions indicated man's superiority, and Rufus, c. 100 A.D., stressed the relative size of the human brain compared with animals (pp. 68, 80–81). Galen, c. 175 A.D., performed significant neurological experiments (p. 86). Early anatomists thought the soul resided in the ventricles (p. 67). Plater demonstrated a brain tumor as cause of mental disorder (p. 101). Avicenna, c. 1020 A.D., believed "epilepsy" curable by malaria (p. 95). The Talmud explained mental disorder only naturalistically (p. 28).

Psychotherapy as such has a long history (pp. 6, 9, 55, 57, 94). Hippocrates thought dreams important for understanding cases (p. 66). Following a considerable tradition about the pulse, Avicenna, c. 1020, uncovered a love affair by keeping his finger on the patient's pulse while the names of towns, streets, and persons were enumerated (pp. 177, 182, 96). Wierus, c. 1560, exposed the trickery in a girl's famous "feats of fasting" (p. 146). At about the same time Plater pointed out that true idiots can be known by their actions and their inability to learn (p. 101).

W. S. Taylor.

Smith College.

Westburgh, Edward M., *Introduction to Clinical Psychology: For Students of Medicine, Psychology and Nursing.* Philadelphia: P. Blakiston's Son and Company, Inc., 1937. Pp. xiii+336.

This is a curiously uneven book. Professedly written for "those who, at least, have had introductory courses in general, theoretical and experimental psychology," much of it is written at too elementary a level for its audience. One feels that the author has covered too much ground too superficially. The style is choppy and somewhat stilted, and the book does not make easy reading. The inclusion of

numerous colloquialisms such as "house broken," "playing with fire," "dog's life," etc., all elaborately set off by quotation marks, creates an impression of deliberate condescension rather than the pleasant informality no doubt intended.

The first seven pages of the introductory chapter on "The Growth of Psychology" run from Aristotle to the present. The result is a bare catalogue of names. The remaining nine pages are devoted to a direct quotation from Freud's *Encyclopaedia Britannica* article on psychoanalysis. The chapter on "Test Results" is a simple, sane discussion of the significance of the statistical concepts found in testing. In the subsequent chapters dealing with cognitive and affective factors the author sets forth his own basic approach. It is distinctly English in tone with a heavy reliance on "capacities" (faculties?) such as discrimination, coördination, apprehension, etc.; and a treatment of emotion through instincts, sentiments, and interests. (The behavior of explorers is attributed to a migratory instinct.) The final chapter on "Some Fundamental Concepts" contains a defense of the clinical method as transcending the merely experimental, and a brief, but good, discussion of the rôle of the clinical psychologist and his relation to the patient. It is the best chapter in the book.

The eighteen-page index is exceedingly thorough; and there is an appendix containing a detailed outline for the clinical study of personality, a list of tests available, and a selected bibliography.

William A. Hunt.

New York State Psychiatric Institute.

Neustatter, W. Lindesay, *Modern Psychology in Practice.* Philadelphia: P. Blakiston's Son and Company, 1937. Pp. xv+299.

This is an excellent little book. Written primarily for the medical student, it will be enjoyed by the psychologist as well. Since it covers the entire field of medical psychology one gets the impression at times that one is rushing along at breath-taking speed. Good organization, lucid presentation, and a pleasant style render the experience a pleasant one, however, and not in the least confusing. The book opens with a discussion of the general principles of psychopathology and the different approaches to it. Then comes a survey of the disorders of childhood, ranging from anxiety problems through those of speech, bladder and bowel control, mental defect, and even vocational guidance. Adult disorders are treated next with the neuroses, psychoses, organic, and toxic conditions all covered. There are two particularly sane chapters on the sexual functions. There follows a section

on methods of treatment; and brief chapters on causation and prophylaxis, and legal problems of disposal. There is even a stimulating chapter on that relatively neglected field—the psychology of the common illnesses such as asthma, rheumatism, heart trouble, etc. The author's own position is one of eclecticism with mild leanings toward analysis. One often wishes that there were a deeper treatment of some subjects, but this is difficult in an outline of this sort. While it is written in a very readable, non-technical manner, all the strict medical terms are there for those who wish them. Such brief, but comprehensive, outlines fill a distinct need, particularly when they are as well written as this one.

There is a brief bibliography for further reading, and a short index. WILLIAM A. HUNT.

New York State Psychiatric Institute.

WARDEN, CARL J., JENKINS, THEO. N., and WARNER, LUCIEN H., *Comparative Psychology: Vertebrates.* New York: The Ronald Press Company, 1936. Pp. x+560.

This monumental book, the second of a three-volume work on comparative psychology to be published by the above authors, is really the third volume of the set. Volume I, appearing in 1935, dealt with principles and methods. Volume II, as yet unpublished, will deal with plants and invertebrates.

Chapter titles run as follows: " Pisces " (94 pages); "Amphibia " (94 pages); " Reptilia " (34 pages); "Aves " (86 pages); " Mammalia," except primates (105 pages); and " Primates " (58 pages). There are 80 illustrations, 2,030 bibliographical citations, and a key to the abbreviations of periodicals cited in the three volumes. Each chapter has two main subdivisions: *Receptive Capacities* and *Reactive Capacities.* Under the first caption appear the factual data concerning physical and chemical stimuli to which vertebrates react, sensory acuity, discrimination, and other complex perceptual functions. Under the second are found diverse subtitles and factual summaries relating to simple reactions, locomotion, orientation, eating, attack and defense, reproduction, parental behavior, group reactions, motivation, and modifiability in learning situations. As would be expected, these two subdivisions are not mutually exclusive because sensory capacities usually are determined through the medium of reactive capacities; nevertheless, the adopted subdivisions have some pragmatic value. Approximately half of the book is devoted to receptive capacities and slightly less than half to reactive capacities. Here and there brief summaries appear (more of these would prove advan-

tageous to the reader). There are no repetitious summaries of principles and methods, these subjects being adequately covered in Volume I.

A handbook of this kind is likely to be rather dull reading for, unfortunately, cryptic statements of fact, lifted from their natural settings, are inevitably divested of some of their inherent interest and significance. In the present volume, however, this expected shortcoming appears to be minimal. A fine scientific vocabulary, lucid style, technically good illustrations, and judicious choice of subjects to be reported in greater detail than would be possible for most items, sustain the attention and hold the interest of the reader in every chapter.

Possibly the following adverse criticisms of the volume are warranted. One feels that a scarcity of evaluative remarks by the authors in their exposition of controversial topics, which are numerous in the book, has a leveling effect upon the factual contributions, ofttimes leaving the reader in a quandary as to which way the truth probably lies and as to which of the studies are to be given greatest weight because of the special care of the experimenters, their experience and reputation in the field, or other evidence available to the authors but not suitable for inclusion in the text. Probably this criticism should be regarded as one of minor rather than of major importance since authors easily go astray when attempting to cast a deciding vote on controversial topics.

The second criticism pertains to what is absent rather than to what is present. One who has read Volume I and the six chapters of this one is in an expectant mood for a final interpretative chapter in which the factual summaries are related to the broader principles and problems of psychology and biology introduced but only briefly discussed in Volume I. Without a chapter of this kind the reader receives no impression as to what specific objectives have been attained in the field of comparative psychology, what new light has been shed on old problems, what services the investigations have rendered to the cause of aiding scientists to understand the outer and inner world of the animal. Possibly the authors are not yet ready to release an interpretative summary of this type. Nevertheless, the readers would like it and I believe will feel that they have been 'short-changed' because of its absence from this, the final volume of the series.

CALVIN P. STONE.

Stanford University.

BOOKS RECEIVED

ALLPORT, G. W., *Personality: A Psychological Interpretation.* New York: Henry Holt and Company, 1937. Pp. xiv+588.

BENNITT, C., *The Real Use of the Unconscious.* New York: The Dial Press, Inc., 1937. Pp. vii+380.

BRANDT, H., WILLIAMS, H. M., and CARLSON, H. S., *Studies in Emotional Adjustment.* University of Iowa Studies, Studies in Child Welfare, Vol. XIII, No. 4. Iowa City: University of Iowa, 1937. Pp. 102.

DANTZIG, T., *Aspects of Science.* New York: The Macmillan Company, 1937. Pp. xi+285.

DI NAPOLI, P. J., *Homework in the New York City Elementary Schools.* T. C. Contr. to Educ., No. 719. New York: Bureau of Publications, Teachers College, Columbia University, 1937. Pp. 60.

GARRETT, H. E., *Statistics in Psychology and Education.* (Second Edition.) New York: Longmans, Green and Company, 1937. Pp. xiv+493.

HOLMES, R. W., *The Idealism of Giovanni Gentile.* New York: The Macmillan Company, 1937. Pp. xvii+264.

HOPKINS, L. T., and Collaborators, *Integration: Its Meaning and Application.* New York: D. Appleton-Century Company, 1937. Pp. xiii+315.

KELLER, F. S., *The Definition of Psychology.* New York: D. Appleton-Century Company, 1937. Pp. vi+111.

MENNINGER, K. A., *The Human Mind.* (Second Edition.) New York: Alfred A. Knopf, 1937. Pp. xiii+504+xiii.

MURPHY, L. B., *Social Behavior and Child Personality: An Exploratory Study of Some Roots of Sympathy.* New York: Columbia University Press, 1937. Pp. ix+344.

STAGNER, R., *Psychology of Personality.* New York: McGraw-Hill Book Company, Inc., 1937. Pp. xi+465.

NOTES AND NEWS

Dr. Roy M. Dorcus, associate professor of psychology at the Johns Hopkins University, has resigned to accept a position in the University of California at Los Angeles. He will be associated with Dr. Knight Dunlap, who resigned in 1935 as professor of experimental psychology at the Johns Hopkins University.—*Science.*

Dr. John G. Jenkins, now assistant professor of psychology at Cornell University, will begin his duties at the University of Maryland as professor of psychology and head of that department in February, 1938. Plans have been made to establish there a departmental program based upon and concerned with the various phases of psychotechnology.

Dr. Floyd L. Ruch, of the Pennsylvania State College, has been appointed associate professor of psychology at the University of Southern California.

Margaret R. Hubbard, A.B., Vassar, 1937, has been appointed research fellow in psychology for the year 1937–1938 at Hobart College.

Among those on whom the doctor's degree, *honoris causa,* was conferred at the recent celebration of the hundredth anniversary of the University of Athens was Dr. Edward L. Thorndike, director of the Institute of Educational Research of Teachers College, Columbia University.—*Science.*

Dr. P. H. Ewert, associate professor of psychology at the University of Vermont, died on September 14.

Dr. Melvin E. Haggerty, dean of the education department of the University of Minnesota, president of the National Association of College Teachers and an authority on educational psychology, died on October 6.—*Science.*

An American Association of Applied Psychologists was organized at Minneapolis August 30 and 31, 1937. It succeeds the Association of Consulting Psychologists and will continue the *Journal* of that society, but consists of four sections covering all the chief fields of

application of psychology. About four hundred psychologists were in attendance at the organization meetings. Dr. Douglas Fryer of New York University was chosen president and Dr. Horace B. English of Ohio State University, executive secretary. Section chairmen chosen were: Dr. Andrew W. Brown, Institute of Juvenile Research of Illinois, for clinical psychology; Dr. Richard H. Paynter, Long Island University, for consulting psychology; Dr. P. M. Symonds, Columbia University, for educational psychology; and Dr. H. E. Burtt, Ohio State University, for industrial and business psychology.

ANNOUNCEMENT has been made of the organization of the Institute for Propaganda Analysis, 132 Morningside Drive, New York City, and of the publication of its monthly letter, *Propaganda Analysis,* at a yearly subscription rate of $2.00. Hadley Cantril, associate professor of psychology, Princeton University, is president; Ernest O. Melby, dean of the School of Education, Northwestern University, vice-president; Clyde R. Miller, associate professor of education, Teachers College, Columbia University, secretary; and Robert K. Speer, professor of education, New York University, treasurer.

The Institute is a non-profit corporation organized for the purpose of carrying on scientific research in methods used by propagandists in influencing public opinion. Money to begin its work has been given by the Good Will Fund, Inc., a charitable corporation financed by the late Edward A. Filene. It is hoped that eventually the Institute will be self-supporting. Income from the sale of its letters and donations from organizations and individuals will be used to increase the scope of its research and to permit it to issue special letters or bulletins when occasions warrant.

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ORIGINAL CONTRIBUTIONS, SHORT ARTICLES, REPORTS, NOTES

BOOKS REVIEWED

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VOL. XXV

107. **Retroactive Inhibition as Affected by Conditions of Learning.** EDWARD CHACE TOLMAN. Pp. 50. 75 cents. 108. **University of Iowa Studies in Psychology, No. 7.** CARL E. SEASHORE. Pp. 163. $1.75. 109. **A Higher Scale of Mental Measurement and its Application to Cases of Insanity.** A. J. ROSANOFF, HELEN E. MARTIN and ISABEL R. ROSANOFF. Pp. 113. $1.50. 111. **The Interference of Will-Impulses.** ABRAHAM A. ROBACK. Pp. 158. $1.75.

VOL. XXVI.

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